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MODELS OF THE DEVELOPMENT OF YAKIMA DEFORMATION

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1.1 INTRODUCTION

This report is an attempt at modeling deformations in the Columbia Plateau (CP), primarily their kinematics, but also with some considerations of their dynamics. Detailed information available on the Columbia Plateau itself, especially information contained in WPPSS PSAR Amendment 23 (1977) is presented first. However, in the course of analysis it soon became evident that the interpretation must be enlarged to involve the behavior of the surrounding tectonic units and their relation to the plate boundaries. The scope of the analysis had to be widened in both space and time. The central theme remains Columbia Plateau deformation, and it is modeled in more detail and sophistication than the regional frame.

A particular problem is the deep structures associated with observed surface deformation. For an educated guess - and this is all that is possible at present - geological and geophysical information must be combined and viewed in combination with what is known about similar situations in other parts of the world. These deep structures are important, of course, for earthquake generation, and deserve considerable interpretational effort.

2.1 THE REGIONAL FRAME

An up-to-date review of the geological development of the Pacific NW in the light of plate tectonics concepts is given by Davis (1977), and is accompanied by an extensive bibliography.

Eaton (1979) has attempted to fit late Cenozoic structural events, and particularly spreading, in the western United States into a plate tectonics framework. The time of initiation of spreading in the southern Basin and Range province is not well fixed though extensional block faulting seems to have begun about 17 my ago. It began to wane 10 my ago. Extension in the northern Basin and Range (BR) province, including the Columbia Plateau (CP), also began about 17 my ago, while the Mendocino triple junction lay far to the south. Spreading in large parts of the western US continues today, but with a spreading direction different from that active at earlier times (Eaton, 1979, Figure 7).

The relations between the North American, Farallon and Pacific plates underwent various, sometimes drastic changes in the course of events. As a consequence, the various regions of late Cenozoic extension today differ greatly in their topography, structure, and geophysical properties.

This is particularly true for the Columbia Plateau. Between 17 and 14 my ago it was extended in a WSW direction as evidenced by the dyke swarms associated with the Columbia River (CR) basalts. This extension direction agrees with the general direction of extension in the western US at that time (Eaton, 1979, Figures 2a, 3b, 7b). The subsequent deformation of the CR basalts, which is the main concern of this report, is of an entirely different nature, and yet is evidently related to the other plate boundary deformations in the western US. In Eaton's perspective (1979, Figure 7d)), dextral shearing along the Pacific-North America plate boundary now drags along and rotates dextrally a number of splinters of the North American Plate around a pivot somewhere in Manitoba. This regional picture agrees in important ways with the inferences based on the local analysis of CP deformation. In the south, lithospheric rock masses were moved away from the great centers of rifting and crustal stretching such as the Rio Grande rift and the Battle Mountain thermal high-Snake River plain, and were piled up in the north against the highlands of northern Washington and British Columbia. The result is a NNW directed compression in the Columbia Plateau, in agreement with the predominant ENE trend of its folds and also with inferred dextral and sinistral movements along NW and NE trending lineaments, respectively. The Neogene kinematics of the Pacific NW in this view is dominated by adjustments within a mosaic of blocks subjected to NNW compression. Release of this compression to some extent followed pre-existing structures (zones of low strength) though it was dominated by the regional stress field. The structures reflect the stress trajectories and boundary constraints, which, in turn are governed by inherited structures, though often in a complex and unexpected way.

3.1 KINEMATIC MODELING: THE GENERAL PROBLEM

Geologic deformation is characterized by belts of concentrated deformation, separating slightly deformed, virtually rigid domains. Globally, this principle is a central tenet of plate tectonics, but similar observations are valid on a smaller scale. Plates and plate boundary zones may be sub-divided into sub-plates and blocks and sub-blocks. These in turn may be recognized to consist of even smaller sub-units with their own comparatively mobile boundary zones etc.

In modeling the kinematics of a region in terms of a block mosaic the first choice concerns the degree of refinement that is desirable for a specific purpose. In this report the Columbia Plateau will first be treated in a

semi-detailed way, then it will be embedded in a more crudely defined belt of blocks that connects the B & R with the Pacific plate boundary. In addition, there will be some considerations which transcend these levels of refinement both towards an even higher regionality on the one hand, and towards local details on the other.

Rigid-block kinematics consist of translations and rotations which, except for trivial cases, are geometrically not quite compatible among the various blocks of the system. It is these imcompatibilities of rigid motions that must be adjusted for in the deformation zones. Large-scale incompatibilities in the brittle domain are accommodated along block boundaries of decreasing grain size down to fault gouge. As modeling requires discretization (dissection of the continuum into rigid blocks) of limited resolution, incompatibilities cannot be completely eliminated but will be shown and discussed (compare Hildebrand-Mittlefehldt, 1979).

The type of difficulty that arises is well illustrated by McGill and Stromquist (1979), e.g. Figure 7b, which depicts an experiment. In that figure (redrawn as Figure 2 of this report), the mass that has moved to the left with respect to its surroundings may as a first approximation be considered as one block, bounded on the right by an extensional fault, and near the upper and lower margins of the figure by dextral and sinistral strike-slip ("transform") faults respectively. On the left, the mass moves into free space; in nature this would be a thrust fault if the free space is occupied by some competent material, or it may be an island arc that is largely decoupled from a receding subduction zone (e.g. Cascades; compare Figure 1e) and overrides the subducted slab with little frictional resistance, leaving in its wake an extended back-arc domain; or it may be space offered by a plate moving away from a ridge (e.g., Juan de Fuca Ridge).

This first-approximation block is subdivided by a network of faults into ever finer sub-units, and its boundaries are broad zones of distributed deformation rather than single clear-cut faults. This is particularly true for the lateral strike-slip boundaries which are a clear kinematic necessity though hard to define in the experiment and would not be directly mappable in nature; here they must be inferred from the general distribution of mapped faults and folds.

Poorly defined boundaries of this type are the "postulated distributed transform structures" of Eaton (1979, Figure 1 and Table 1) and also the block boundaries of the CP and

its surroundings are of this nature. Such boundaries cannot be simply mapped but clearly exist and play a key role in the kinematic development.

In choosing boundaries of blocks and subblocks there may be a degree of arbitrariness as one lineup of apparently (on the mapping scale) unconnected structures is preferred to another. This difficulty arises in block modeling generally and in the blocks surrounding the CP in particular. The reasons for choosing such boundaries will be given, but there is doubtlessly much room for improvement. However, the aim of the exercise is to sketch the general relationship of deformation in the CP with the plate boundary, and this is not sensitive to a large variation in the block boundaries.

While none of the block mosaics occurring in nature consists of discrete, rigid bodies, it is nevertheless necessary to begin considerations with simple rigid bodies and relax this condition of rigidity as the necessity arises. The more important topics to be discussed are:

1. Material balance.
2. Stress field and transport field (deformation permitted at block boundaries).
3. Relationship of various parts of a transport field.

3.1.1 MATERIAL BALANCE

Matter is conserved during deformation. For shallow deformation down to a depth of about 10 km this implies conservation of volume or, on a cross section, of area, within the limits of observational errors. Particular applications are:

a) Matter accumulated in compressional features (which are sinks in a transport field) must be taken away from extensional areas (the sources of the field). Sources and sinks in a closed system are of equal magnitude. If the system is not closed, movement of matter across its boundaries may be estimated. (Figures 3, 4.)

b) Compression (shortening) may be estimated on cross sections (Figure 4.):

   1) Curvimetrically, by restoring the undeformed continuation of beds and measuring the

difference in distance across the deformed feature before and after deformation (Ds).

2) Volumetrically (actually areally on cross sections), by measuring the volume of matter squeezed out above the undeformed horizon (Dv).

Dv/Ds gives a figure for the thickness (z) of section involved in the deformation. This is particularly important for the question of how much decollement on the base of the Yakima basalts is involved in CP folding. This is one of the rules for the construction of "balanced sections."

3.1.2 STRESS FIELD AND TRANSPORT FIELD

Principal stress trajectories and the geometry of the stress field: the geometry of deformational features in a general way defines the stress field in which deformation has taken place. Although all structures with finite displacement grow in a stress field that varies with time, phases of movement may often be recognized where deformation took place under reasonably constant conditions. In particular:

a) The overall bearing and plunge of anticlinal axes and strike of normal and thrust faults coincides with the intermediate principal stress trajectory sigma 2. In shallow deformation another trajectory also is horizontal and perpendicular to sigma 2. For anticlines and thrusts the other horizontal trajectory is the principal compression or sigma 1.

b) Deflection of structures, particularly folds, define local or regional boundary conditions for the stress and more pronouncedly the transport field, such as pre-existing material, irregularities (faults, edges of incompetent beds, etc.), or block boundaries of a higher order. This is a geological application of the "de Saint-Venant principle" of mechanics, which states that the domain of influence of an irregularity on the stress field is of a size comparable to that of the irregularity itself.

3.1.3 RELATIONSHIP OF VARIOUS PARTS OF A TRANSPORT FIELD

The local vectors of the transport field are assumed to have the direction of sigma 1 or sigma 3 (in extensional areas) and a length corresponding to the amount of deformation as established by material balance calculations. A general

field of transport is very complex. Fortunately for shallow geological deformations, several simplifications are usually possible:

a) Compression and extension (sinks and sources) may often be assigned a geometrically simple distribution, at least at the level of quantitative sophistication called for by the quality of geological and geophysical data. Often their domains are separated, and frequently they are confined, particularly to boundaries of blocks (or plates) of insignificant internal deformation. These block boundaries are, in fact, always diffuse to some extent, even if shown on a map as a line, and sometimes they cannot be defined by direct observation: They often must be inferred from evident differences of movement across a zone of some width (compare p. 3). In other words: block boundaries may sometimes be approximated by first order discontinuities in the vector field of transport, and more often by second or higher order discontinuities. In these cases, there is a finite gradient across the boundary. Thus, the CP may be subdivided into a number of blocks of different orders of importance, and with boundaries of different orders of discontinuity. The same holds for the surroundings of the CP (IDOL - mosaic, Figure 14).

b) The 3-dimensional field of transport may be separated to a large extent into component 2-dimensional fields that may be modeled on a map view or cross section. Thus, the distribution of sinks (compression in folds and thrusts) and sources (extension particularly across normal faults) in the CP region may be modeled on a map, and the distribution of vertical components of movement may be superposed on cross sections.

c) The rigid blocks or polygons in a plane 2-dimensional field move by a superposition of translations and rotations. In the general case this leads to an extremely bewildering result. However, there usually is a hierarchy of quantitative importance of both translations and rotations, and a rational analysis demands that the first order ones be dealt with first, that the error between a first order model and observed quantities be estimated, and that this error be

then reduced by superposing second order movements - again an iteration procedure that should be continued only as far as the quality of the information warrants and the occasion demands. With some experience, the first guesses may not be too bad, although generally some trials are necessary. The process should begin with first order translation as it is both easier to model and geometrically simpler to accommodate in nature. Rotations invariably lead to rigid-body incompatibilities in compressional domains which are eased by dilatancy on the one hand, and diffusion of adjustments on the other.

4.1 MODELING EN ECHELON FOLD BELTS

One of the many difficulties in modeling is that of en echelon fold belts such as CLEW. Because of their 3-dimensional complexity and non-linear development (changing material distributions and boundary conditions) little is known about them theoretically. Insight of a largely qualitative and intuitive nature must be sought by comparison with known natural and experimental belts.

Intriguing cross-sectional and plan-view deformational pictures are provided by the sandbox experiments of Emmons (1969) although the boundary conditions of his divided container are not very realistic. The main point that is illustrated is oblique and non-parallel mass transport on warped fault surfaces which anastomose and dissect the sand body into an ever finer mosaic of quasi-rigid blocks ("reticulation"). Due to the complex mass transport, domains of compression are followed closely by domains of extension.

Evidently, mass balance considerations on cross sections are rather inadequate in this situation, and only semi-quantitative estimates are possible.

Comparison with such illustrations as Figure 6 of Harding and Lowell (1979), here redrawn as Figure 5, and Figures 3 and 4 of Emmons (1969), suggest an estimate of depth for the basal shear that drives the en echelon deformation. The compressive deformation is contained in a wedge whose boundary dips at about 45° (a little less in Figures 3 and 4 of Emmons). The depth to basal drive is consequently about half the width of the fold belt. Similar results may be inferred from other publications.

En echelon structures are common because blocks and subblocks of the earth's crust usually move somewhat differentially, and the earth is generally horizontally or subhorizontally layered to some extent with prominent competent and incompetent intervals at various levels.

It follows that en echelon belts of different depths of decollement may be superposed.

In CLEW this is clearly the case. The total width of the belt is 30 - 40 km but the subbelt designated as RAW in Figure 15e consists of brachy-anticlines less than 5 km or even 3 km wide which points to a depth of decollement of less than 2 km or approximately at the base of the Yakima (CR) basalts. There may be local decollement horizons or even gradational decollement intervals at intermediate depths. This is suggested, e.g., by the Selah Butte trend of brachy-anticlines (see Figure 15, Stage 7 and Figure 24).

In addition to variations in the depth of superposed en echelon belts, there is a variation of angle between the axes of individual brachy-anticlines and the average strike of the entire belt. Angles of 30° or 40° are frequent (Wilcox et al., 1973, Figure 9, Figure 11) but angles of less than 20° or even 10° are characteristic of some belts such as the Newport-Inglewood trend (Harding, 1973, Figure 7). Much seems to depend on the relation of the local stress field to local inhomogeneities such as faults, or basins and highs; later en echelon folds tend to have smaller angles (Wilcox et al., 1973, p. 79). For the deep en echelon belt of CLEW the angle is typically a little more than 20° (Yakima Ridge, Rattlesnake Hills) but for RAW it is usually less than 10°. For HOOK it is again 20° to 30°.

While short folds (brachy-anticlines) are typical for oblique shear with a compressive component (oblique-convergent boundary), they are not the only structures but are usually affected by and interfere with a maze of other complex faults (compare Harding, 1973, Figure 7; Harding and Lowell, 1979, Figure 6). In experiments such faults seem to have various origins. In the clay experiments of Wilcox et al. (1973) a pattern of conjugate shears develop (synthetic and antithetic with respect to the master shear, also called Riedel shears and conjugate Riedel shears) and bear the usual Mohr relationship to the strain ellipse. Although often irregular in detail, they are very regular as a set.

In the CP the situation is more complex. Wrench movement in RAW is superposed on that in CLEW, and the Yakima folds

affect a large domain that includes CLEW. Each deformational system may be expected to develop its own set of shears which compete and influence each other mutually. Closely spaced joint and shear patterns criss-crossing the CRB are evident from the air and are well represented on topographic contour maps (e.g. sheet Walla Walla, 1:250'000). Topograhic features suggest that RAW is affected by small synthetic Riedel shears similar to those shown by Harding (1973, Figure 7) for the Newport-Inglewood trend. It is possible that the Thrall-Wymer-Selah Butte cross-trend of CLEW developed on an early synthetic Riedel shear that subsequently influenced the main deformation (see Figure 15, Stage 7).

As displacement increases, the faults acquire the complex geometry (3-dimensionally warped, reticulating system) and variable kinematic function typical for mature wrench zones (Emmons, 1969).

In conclusion, it is obvious that in the modeling of en echelon zones drastic simplifications are necessary to keep them manageable.

5.1 LOCAL OBSERVATIONS

5.1.1 DEFORMATION STYLE AND REHOLOGY

Observation on good outcrops bears out what is known from other areas that have been deformed under small overburden and at low temperature, and agrees with the results of deformation experiments under similar conditions in the laboratory. Basalts, as well as inter-flow sediments deformed in an essentially brittle manner. Several types of brittle failure have been observed, and they are schematically illustrated in Figure 6. They are commonly superposed on each other, and sometimes the sequence of superposition may be demonstrated. Mohr-Coulomb type thrust-faults cut bedding at an angle less than 45 degrees (usually even less than 30 degrees) with little or no rotation of the beds. On the other hand, they often occur within a sequence of rotated or folded beds while still maintaining their angular relationship with bedding; these thrusts were rotated or even folded after they had formed. Such folded thrusts are well documented from many fold belts. Particularly interesting are those that may be observed on Manastash Ridge along Interstate 82 and its surroundings. The main thrust exposed in the roadcut is doubtless the one that emplaced lower Yakima on middle Yakima rocks (Bentley, 1977, Figure 18 and 19). It is cut by minor secondary thrusts and is accompanied by

smaller-scale deformation both in basalts and sediments. Interestingly, the direction of thrusting is from north to south, from north of the Manastash fold through its limb towards the core of the fold. Based on the results of mapping by Bentley (oral communication), the examination of aerial photographs, and inspection from the air, other more or less parallel thrusts of the same general nature are present and are responsible for the peculiar topography of Manastash Ridge in this area. The thickness of the section repeated by the main thrust may be estimated from Bentley's figures at 200 m to 300 m, which on the assumption of an original dip of thrust of 30 degrees (now somewhat distorted) results in a horizontal compression of 350 m to 520 m. The other thrusts are smaller, and together the amount of thrusting prior to folding is estimated at about 700 m. This is considerably more than the subsequent amount of compression by folding which, after Bentley (1977, Figure 9), is less than 300 m.

On the map (Shannon & Wilson, 1978), the strike of the thrust faults intersect the strike of the north limb of this typically asymmetric fold at an angle of 20 degrees to the southeast, which demonstrates that between thrusting and folding, the geometry of the stress field at this locality had changed (compare the data from Emmons, 1969, for changing patterns of deformation in strike-slip zones).

Folding is often considered a ductile process, but this is not so under the conditions present when the CP folds were formed. Beds are usually fractured to some degree, and in the more steeply-dipping parts of anticlinal limbs they are often thoroughly brecciated. The folds have usually sharp, although rounded hinges, and as a rule are monoclines rather than anticlines, features which set them apart from the sinusoidal concentric folds of folding theory and schematical textbook illustrations. The CP type folds are the result of shearing, similar to kink bands, with the shear couple acting on layers of competent beds which are rotated. The optimum dip angle for the hinge planes is about 60 degrees (compare Paterson and Weiss, 1977) rather than the 30 degrees for Mohr-type thrust faulting. When the hinges are ruptured, a steep reverse fault may result and be of the type that has been reported from the base of some monoclines, e.g., Saddle Mountain. Although CP folding was accompanied by fracturing of the beds which implies sudden release of elastic energy, displacements are small and distributed through large volumes of rock. Of the other types of faults observed, the strike-slip faults are particularly noteworthy. They are easily identified when horizontally striated; however, striations along strike-slip

faults of known displacement are not always well developed, and sometimes later movements of insignificant strength overprint them. Any steep fault plane or breccia zone may be taken as suggestive of strike-slip faulting. The amount of strike-slip displacement can usually be determined only by mapping and subsequent kinematic analysis (compare Figure 12).

5.1.2 THE TIME OF DEFORMATION

The folds are composed of elements of different trend for which, in some instances, a time sequence can be inferred. The question arises whether the CP fold system is the result of the superposition of deformations due to entirely different stress systems associated with regionally different orogenic situations. A first inspection shows this to be highly improbable. Intra-Yakima unconformities have been reported from isolated locations, e.g., a pre-Pomona one from the Yakima ridge northeast of Yakima (Bentley, 1977, Figure 15.). These local unconformities are probably due to landslides or tilting of blocks at the time of the basalt flows. Important interflow compression does not seem reflected in the overall structural relief. Generally the entire Yakima-Ellensburg sequence, including the Clemans Formation and probably also the Thorp Formation (though this is less certain because of lack of good outcrops on the ridge flanks), are folded conformably. Changes of deformational style (thrusts/folds) and of the geometry of the stress field (especially locally) are commonplace in the course of one individual orogenic event and are easy to understand on general grounds: Each break in continuity because of early faulting and any change of geometry because of folding, create new boundaries and boundary conditions. Folds must be visualized as growth features with nonlinear development. Superpositions like those described from Manastash ridge are attributed to different states of the same orogenic event. The test for this conclusion, which is based on inspection, is whether or not the essential features of the CP system can be fitted into a unified kinematic model. A layer of the Thorp Formation has been dated as 3.7 my (Bentley, 1977, Table 1). On Craig's Hill in Ellensburg (Bentley, 1977, page 12) the Thorp Formation is overlain unconformably by the Naneum Conglomerate which is composed of coarse basaltic pebbles suggesting the existence at that time of Yakima basalt ridges although the unconformity may be due to scouring by tributary streams that carried pebbles from the Wenatchee Mountains (Bentley, 1977, page 12). Similar basaltic conglomerates or coarse gravels are found on some of the ridges (oral communication by F. Kienle), and were shown to

me on top of the Horse Heaven ridge where it is crossed by the McBee road by S. Farooqui. Unfortunately there is no way to exactly date and correlate these conglomerates. On Craig's Hill, the Naneum Conglomerate is topped by loess which surprisingly shows remanent magnetism, with reversed polarity, and is, therefore, considered older than 750,000 years (R. Bentley, oral communication). On this very tenuous stratigraphic evidence the main part of Yakima basalt deformation north of Yakima took place between about 3 my and 1 my with some deformation continuing into the younger Pleistocene. Microearthquake activity (Washington Public Power Supply System PSAR Amendment 23) would indicate that the system is still active to some extent even at present.

In some places, deformation seems to be somewhat older. A Thorp gravel layer (3-7 my), apparently undeformed, is reported from the flank of Manastash ridge, and faults near Goldendale are bracketed by lavas of 4.5 and 3.5 my, resp. (compare Davis, 1977, page C-24). Perhaps the main movements 10 - 7 my ago on the John Day fault (Robin, 1977; Davis, 1977, page C-24) should be viewed in this perspective: on the whole, Yakima deformation seems to have begun on the south of the Yakima block (page 33 and following, see also Figures 15 and 16) and proceeded to the north, although exceptions to this rule should be expected.

6.1 A QUALITATIVE ASSESSMENT OF CP KINEMATICS BY INSPECTION

For the sort of iterative, quantitive approach to kinematic analysis as outlined in the introduction, an educated guess by inspection must be made for an initial input. An excellent impression of the entire structural system of the CP may be obtained by looking at the plastic relief map (Figure 7). Because of the young age and the slow erosion of the structures in the desert, topographic relief expresses structural relief semiquantitatively. The CP appears to be subdivided into four main regions:

Region 1:

The topographically (and structurally) most conspicuous region occupies a belt up to about 40 km wide which is present from about Cle Elum in the northwest to Wallula gap on the Columbia River in the southeast. This Cle Elum-Wallula belt - or CLEW for short - is traditionally considered a part of the larger Olympic-Wallowa lineament (OWL) (Bentley, 1977, page 3). The existence of this lineament, at least in the often-voiced sense as a boundary between oceanic and continental crust, has been questioned

by Davis (1977, Page 53) and for the time being it would appear wiser to confine it to CLEW which not only exists but is clearly the most conspicuous structure of the CP. It is composed of a system of mostly faulted east-southeast-trending folds, or of fold segments deflected in that direction, where the long east to east-northeast-trending folds enter CLEW. This pattern forms a right-lateral en echelon belt. It indicates deep-seated right-lateral shear that drives a deformable sequence of partially decoupled more superficial layers (Emmons, 1969; Wilcox et al., 1973; Harding & Lowell, 1979). The process is easily demonstrated by pasting tissue paper with some sticky fluid to stiff board that had previously been sawed in half, and moving the board along the cut in a horizontal, right-lateral sense. This demonstration helps visualize the process, but should not, of course, be taken as an experiment reproducing mechanical conditions in the earth. As the paper is folded in some places, it must be stretched in other places to maintain material balance. In the CLEW, compression far exceeds any extension that may also be present. Thus, the two most important components of motion are dextral strike-slip along and compression across CLEW.

Region 2:

The triangular region southwest of CLEW, bordered on the other two sides roughly by the Columbia River and the eastern margin of the Cascades, is characterized by a series of long, narrow ridges with an impressively regular spacing of 30 km. The ridges, although somewhat undulating, maintain a generally parallel east-northeast trend up to CLEW where they are deflected, sometimes abruptly, to the southeast. These regular ridges mark anticlines that indicate a rather regular stress field with the trajectories of maximum compression trending north-northwest. The kinematic (transport) vector points to the north-northwest as the folds are deflected dextrally at CLEW. Movement with respect to the northeastern region has been to the north-northwest. The regularity of the features implies horizontal translational movement, and the smaller superposed irregularities suggest some degree of superposed rotation. The direction of movement has a component of compression across CLEW, and a component of dextral strike-slip along it, which is consistent with the findings on CLEW itself.

The narrow ridges are superposed on broad, gentle structures that are about 30 km wide and may be parallel to the ridges, or parallel to CLEW. This bimodal distribution of structural width suggests a bimodal distribution in the

thickness of crustal layers involved in the deformation which, in turn, implies a certain amount of decoupling or detachment at two levels (compare Figure 8, 8a, 16). Such a detachment is already intimated by the en echelon fold belt on CLEW (see above). A first guess would be that the narrow features are due to local decollement at the base of the Yakima basalts, and that the wide blocks have a vertical thickness of at least 10 km and possibly as much as 20 km. The overall structural relief suggests that vertical movements are superposed on the compressional, horizontal ones. As is evident from the geologic history as well as geophysical data, CP has been involved in isostatic adjustments to tectono-thermal events since the beginning of the Tertiary (see p. 27-51).

Region 3:

The northeastern region, again a triangular area, is bordered on the southwest by CLEW, on the east by a line that trends approximately north from Pasco to the northern margin of the CP, and on the northwest by the margin of CP (for a more detailed argumentation of block boundaries in the IDOL mosaic that contains this region, see p. 22 and following). In many ways it resembles a subdued replica of the southwestern region, inasmuch as some narrow, widely spaced ridges are present, the most conspicuous one being Saddle Mountain. On the average they strike about east-west and are dextrally deflected at CLEW. Badger Mountain, the very small northernmost fold near Wenatchee strikes northwest. On the average, horizontal translational movement to the north seems to predominate.

Region 4:

The eastern region comprises the rest of the CP to the east of the northeastern region. It is deformed only slightly and might be considered practically underformed (although in Figures 13, 14 it is subdivided as part of the IDOL block mosaic). This implies that its western boundary is a zone of slight dextral strike-slip which must be dispersed as no fault is readily discernible.

In order to fully define a kinematic model operative in the CP, all of its boundaries and relative motions with respect to surrounding terranes should be defined as well. In Figure 14 and the accompanying tables and explanations, an attempt is made to define an internally consistent kinematic model. Here it should suffice to say that in principle a variety of boundary movements is compatible with the kinematics of the CP itself. For example, a particularly

simple solution interprets the CP deformations to be nested in a nook of an N-S trending strike-slip system: this solution in its most elementary form was proposed in a previous, preliminary draft of this report for want of more precise information (see Figure 1(d) and Davis, 1977, Figure 7); indeed one may maintain that as a rule in scientific synthesis, that solution should be envisaged pro tempore which offers the simplest explanation. In the case of the CP, subsequent information called for a more complex solution which is presented in the conceptual framework of block mosaic kinematics in Figures 14 and 14a. However, in principle, even in this more complex solution, the CP folds are still in a nook of the dextral strike-slip system that characterizes the western boundary region of the North American Plate (Figure 9). In addition, it should be noted that a predecessor of CP compression formed the late Oligocene - early Miocene Kachess-Naches-Blue Mountains-Aldrich Mountain system (Davis, 1977; see Figures 1(a) and 15, Stage 1 of this report). Although known only in fragments, this system bears a resemblance to the early kinematic model (compare Figures 1, 9) inasmuch as it calls for reactivation on the southern part of the Straight Creek fault zone which at Cle Elum bends into CLEW; what happens below the CR basalts is not known, but south of it there was compression with an average N-S direction.

7.1 A QUANTIFICATION OF THE KINEMATIC MODEL

Magnitudes of shortening may be obtained by measuring cross-sections according to the method sketched on p. 3-4. Their quality depends on the quality and quantity of the sections available. Both are generally poor. Supplementary information may be obtained from the topographic relief of the ridges. Strike-slip displacement is not quantifiable directly, as no correlatable features are known that have been dissected, but must be inferred from the difference in compression on the two sides of a boundary. Rotations are even harder to quantify and must often be introduced as corrections of errors created by modeling pure translation. This is the procedure followed in this report: First, pure translation will be quantified. Then the more serious deviations from nature will be corrected by rotations where suggested by inspection.

7.1.1 THE COMPRESSION OF INDIVIDUAL FOLDS (FIGURE 10)

The quality of the information available may be gathered from Shannon & Wilson (1973), Figure 4, which shows a cross section through the Columbia Hills ridge near its maximum development. All that can be safely said is that

correlative members of the Yakima basalt sequence are displaced vertically by about 500 m. The slope is covered by landslides, and the nature of the structure must be interpreted from insight gained elsewhere. Shown on Figure 4 is a normal fault with extension reduced by drag. If instead it were a monocline with a dip of 60 degrees the compression would be 290 m, if there were a reverse fault dipping 60 degrees the compression would be 290 m also, but if it were a clean-cut Mohr-type thrust dipping 30 degrees the shortening would be 870 m. A thrust fault with 500 m displacement was penetrated by a drillhole according to R. Deacon (personal comm.). East-northeastward the ridge (Alder Ridge) loses relief and gradually disappears near Umatilla, where on a small but clearly discernible north-south-striking faulted ridgelet, a new east-northeast striking small ridge reappears at Sillusi Butte. From the figures in Shannon & Wilson (1973) topographical relief largely corresponds to structural relief. Thus, compression along this trend seems to fluctuate between 0 m and 500 m. The fluctuations must be due to either rotations or transfer of movement to other ridges by distributed shear. On p. 35-36 (comments on Figure 15) the framentation of the Columbia Hills structure is discussed. Outcrops do not permit a detailed analysis, and for a first rough quantification, an average of 300 m of shortening along the entire trend would appear reasonable. The Horse Heaven Hills have a relief of only about 1000 feet. Much of their north flank is hidden by landslides, but seems to dip steeply to the north. A 60 degree monocline would give 170 m of shortening, and I assign about 200 m of compression the Horse Heaven Hills in the model. Toppenish Ridge, like Columbia Hills, decreases in relief from west to east, and is a little smaller than Columbia Hills. It should not exceed an average of 200 m of shortening. The western part of the Rattlesnake Hills (Ahtanum Ridge) is more of an anticline than the monoclinal ridges dealt with so far, and it may in some places have as much as 400 m of shortening. East of Union Gap, the Rattlesnake Hills develop into a tilted monocline with a steep north limb with 300 m relief, and only at its deflection point on CLEW does it rapidly increase relief to more than 2000 feet. The new detailed maps by Shannon & Wilson (1978), show that this area is very complex structurally, but for a first approximation to the translational model, an average shortening of 300 m would appear adequate. Yakima Ridge seems more important. At Selah Gap its relief is subdued, as happens wherever the ridges leave CLEW (compare p. 52, 53), but also because it branches out, in a somewhat diffuse way, into the Selah Butte anticline. (For its relation to the most conspicuous anticline of the whole CP fold set, Cleman Mountain, with a

relief of 3000 feet and an overturned southwest limb, see Figures 15, 16). On the average, a shortening of 400 m should be reasonable for Yakima Ridge.

For the ridges following to the north, cross sections do exist, and some may be directly observed in Yakima gorge. They permit more reliable estimates of shortening. Sections through Umtanum Ridge are presented by Bentley (1977, Figure 21 and Figure 25). In the Yakima gorge, at Wymer, Umtanum Ridge is formed by a well exposed, somewhat box-shaped fold with a steeper, faulted north-limb. A shortening of about 700 m may be measured on the section, and the Dv/Ds method referred to in the introduction gives a rough depth to the decollement of about 1300 m below the Vantage horizon, which is near to the base of the Yakima sequence. At Priest Rapids the shape of the fold forming Umtanum Ridge approaches that of a tipped monocline with a steep north limb that is cut by a reverse fault. Shortening is about 600 m, and an average of about 6 km of the rock column is involved. This figure is, however, a mixture of basement involved in the tilted south limb, and folding above the base of Yakima. Umtanum Ridge is assigned an average compression of 600 m. The structure of Manastash Ridge at Interstate 82 was discussed on p. 9. A series of southward directed thrust faults was subsequently folded into the north limb of a monoclinal structure. The sum of the structures approaches 1000 m of shortening. However, the thrusts cut the monoclinal axis obliquely and shortening is reduced along the ridge both to the east and west. In the east near Badger Gap, Manastash Ridge approaches the Saddle Mountains which follows it to the north and is separated from it by slight topographic relief and the Hansen Creek fault zone (Bentley, 1977, Figure 12). Exposures are poor, the aerial photographs are not very helpful, but mapping by Bentley (1977, Figure 11 and Figure 12) discovered a structural relief that, here, far exceeds topographic relief. If Manastash Ridge is to maintain a level of shortening comparable to that found on Interstate 82, then the Hansen Creek fault must have more of a thrust fault character than assumed by Bentley (1977, Figure 11), which on the information available is quite possible. Before it reaches the Columbia River, the Manastash-Hansen Creek structure swings to the southeast and somehow joins Umtanum Ridge. An average of 800 m of shortening is assumed. Saddle Mountain (Bentley, 1977, Figure 27) is an asymmetrical, somewhat box-shaped anticline with a steeper north limb that is cut by a reverse fault. Its structural relief is 280 m; its measurable shortening is 230 m, and the estimated depth to decollement below Saddle Mountain is 1500 m, again somewhere near the base of the Yakima basalt

group. Saddle Mountain is by far the most important structure of the northeastern region 3, and east of Sentinel Gap its relief begins to diminish until it is hardly recognizable east of Skootenay Lake. The eastern boundary of region 3 would pass between Skootenay Lake and Paradise Flats. West of the Columbia River, at the margin of the Kittitas Valley depression, the Saddle Mountains disintegrate into a series of dextral en echelon brachyanticlines: Boylston, East Kittitas, and Whisky Dick ridges. Thereupon it passes into the structures of the Wenatchee Mountains which are a broad uplift bordered by flexures and somewhat faulted internally. The rest of the little folds of the northeastern region 3 are of insignificant shortening which probably totals less than 200 m.

To summarize, the total translational shortening between the Columbia Hills structure in the south and the Kittitas valley depression in the north may be estimated at 2.8 km, and if the Saddle Mountains-Mission Ridge (Wenatchee Mountains) to the north is added, the total is about 3 km. The information on which these estimates are based is poor except where structures are cut by rivers or highways, but nevertheless the order of magnitude should be correct as structural relief is small and material balance considerations do not permit drastic deviations. Even if a revision on more detailed and reliable data were to increase the figure to 5 km, this would still be small compared to other compressional belts.

These figures, then, are our best and fairest input into the translational part of the iterative procedure to approximate the true kinematics quantitatively. If these NNW-translations are performed on a cut-paper model (see Figure 12 and explanations on page 19) with the further assumption that both CLEW and HOOK are fixed boundaries, discrepancies with nature are obvious. The most glaring discrepancy, noticed immediately by comparison with any geological or topographic map (e.g. Figure 7), is the piling-up of shortening components in the southeastern part of CLEW and the SW part of HOOK by the translational model (oblique convergence, compare Figure 3). There are several possible contributions that help remove this discrepancy, but along CLEW the most important are probably dextral rotations. Their pivots should be somewhere north and west of the southern part of CLEW, if the desired correction is to be achieved. This, fortunately, harmonizes with the generally dextral system of the Pacific NW. Indeed, the dextral couple acting across the Columbia Plateau makes a certain amount of dextral rotation all but inescapable. Discrepancies may be eased also by lateral escape of matter

in adjacent blocks of the incasing block mosaic, and this seems to apply particularly to HOOK, see Figure 14a and p. 40.

For a crude assessment of the magnitude of the rotation, Rattlesnake Hills will be examined as an example (Figure 11). For a first attempt take the pivot at the base of the "R". The southeast trending part of the Rattlesnake Hills should have a shortening component of 200 m perpendicular to strike, according to our tentative translational model. In reality, there is a remarkable axial plunge to the southeast and shortening is reduced to practically nil at the southeast end of Red Mountain, 25 km from the pivot. This reduction is achieved by a clockwise rotation of a little less than 1/2 degree. The same rigid rotation adds another 150 m of shortening to the 300 m translational shortening at point 3629, an addition that is probably distributed in the overall complication of the area. By shifting the pivot and introducing other refinements, better results may be obtained, but this is not called for by the quality of the information. By applying such very slight rotations to the other ridges on CLEW, with modifications appropriate for each case, the observed axial plunge of the folds as they cross CLEW is achieved.

To reduce compression normal to CLEW to essentially zero at Wallula Gap in correspondence with observation, a regional rotation must be superposed on the local ones, compare p. 38-40.

Such simple kinematic concepts are best modeled on a transparent sheet of paper (Figure 12). A simplified map of the main structures is drawn, and the paper is cut along a combination of structures assumed to have moved as a kinematic unit. The area (= block; for simplicity usually a polygon) is then moved by the required amounts of translation and rotation, either to scale, or at an exaggerated scale as in Figure 12. The stages of kinematic sequences are added one after the other, and at each stage a copy is made for record. In this way, a quantitative kinematic sequence model is obtained.

In Figure 12, the sequence is assumed to have proceeded from N to S whereas on p. 32 and following a more complex development is favored, with the ridges forming essentially in the opposite (inverse) order. However, for illustration of concepts and techniques this is irrelevant. The amounts of movement are easily read as (if copied on a blank background) shortening (superpositions) result in light-gray stripes, extensions (where the background is exposed) result

in black stripes (not shown in Figure 12), strike-slip motion appears as displacement of the original margins of the sheet, and rotations both as tapering stripes of shortening and angular misfits on the original margins. It is obvious that by combining the translations with slight rotations, shortening along CLEW can be made to vanish at Wallula Gap. Compare Figure 7.

Such models are useful for visualizing the tectonic consequences of rigid body motions. They do not permit, of course, modeling distributed deformation such as that of Figure 2, or the Columbia Plateau realistically.

8.1 THE IDOL BLOCK BELT

For an introduction into the kinematic problems of the terranes encasing CP, see Figure 9. Shown in solid lines is the simplest dextral system which is compatible with the Yakima folds, as shown by Laubscher (1977, Figure 5). The reader was cautioned at the time "that nature must be expected to be much more complex than that. All that the extrapolations imply is that some sort of dextral shear - perhaps widely distributed - should be looked for north of the western margin and south of the eastern margin." Figure 9 illustrates the concept of block mosaic kinematics as a means for such a distribution of motion, in relation to the elementary shear system. The distributed block boundaries are shaded. The block mosaic actually chosen (IDOL) is shown in Figures 13 and 14 and discussed in Tables 1 and 2.

Figures 1, 9, 13, 14 illustrate three important points:

1) The dextral motion in the Pacific NW may be distributed in various ways.

2) N-S compression sometimes squeezes matter upward into free space, as in the Yakima folds, and sometimes squeezes it sideways to the west, as in some of the surrounding blocks: this requires sinistral as well as dextral block boundaries.

3) Depending on the boundary conditions obtained in a certain time interval, comparable stress systems may activate different mosaics. Thus the presumably late Oligocene Naches-Blue Mountains system (see Figure 1(a) and Figure 15, Stage 1) reactivated the southern part of the Straight Creek fault (Kachess Lake fault, Clayton and Miller,

1977) which was subsequently plugged by the Snoqualmie batholith and not activated again to any significant amount by Yakima deformation.

8.1.1 THE IDOL BLOCK BELT (FIGURES 13, 13)

The Yakima block is one of a series of blocks which may be arranged in a belt that constitutes the northern margin of the BR province (Idaho - Olympic belt, or IDOL). Figures 13, 14, and Tables 1 and 2 provide a brief definition and description of the blocks and their boundaries. They are based on the detailed geological and geophysical surveys contained in WPPSS PSAR A 23 and their supplements, complemented by the geological map 1:2,500,000 of the U.S. (USGS, 1974) and the topographical maps 1:250,000 and 1:500,000.

Such blocks and their boundaries are not sharply defined even farther south in BR (Eaton, 1979) where large movements are involved. Here in the IDOL belt, movements are small and structures are often discontinuous, resulting in boundaries that are subject to argument. However, the basic tenet here is that zones of movement, however diffuse, must be part of a continuous and compatible system. In the particular case of IDOL, isolated structures, especially faults which affect Miocene rocks, are considered parts of continuous block boundaries that connect kinematically, however diffusely, with the deformations of the CP.

Table 1 lists the chosen block boundaries and their definitions, and Table 2 is a list of the blocks themselves and their definitions. For ease of reference the elements are given symbols which are also used on the maps.

TABLE 1: The block boundaries of IDOL

Map Symbol	Name	Description	Comments
ON	Olympic-Naches	Faulted Neogene sediments along the Straits of Juan de Fuca. Young block faulting bordering the deep Seattle low in the Puget Sound depression (gravity). Deformed Miocene in the Green River-Naches River domain.	Northwestern part of the Olympic-Wallowa lineament (OWL, Raisz 1945, Bentley 1977, Hammond 1979)
CLEW	Cle Elum-Wallula Gap	Northeastern boundary of main Yakima folds, with dextral deflections and en echelon folds which form a belt 30-40 km wide. Intermittantly faulted.	Central part of OWL, bordering Yakima block and therefore kinematically distinct and topographically prominent.
BL	Boise-La Grande	Begins in the southeast as a prominent boundary fault zone between the western Snake River plain and the Idaho batholith, and then trends as a belt of apparently discontinuous faults through the border zone of the Wallowa mountains and the La Grande depression, into the Vansycle-Walla Walla fault zone, to join CLEW at Wallula Gap.	This is a gross simplification as faulting north of the Snake River plain is very distributed. Nevertheless, it appears that the Wallowa mountains are less faulted than the area to the SW and are therefore kinematically bounded by a distributed zone of motion. Contains the southeastern part of OWL.
NS	North Snake River	Continues BL to the southeast.	
PG	Boise-Payette-Grangeville	Main border zone between CR basalts and Idaho batholith.	Trends towards the Lewis and Clark line (LC, Eaton 1978, USGS Prof. Papers 1100).

LC	Lewis and Clark Line	"A 16 to 50 km-wide zone of en echelon right lateral and oblique slip faults marking the northeast limit of Late-Cenozoic basin-range faulting" (Eaton 1979, p. 11). To the west it disappears below the CP basalts but is recognizable as a belt of increased gravity gradient that crosses the basalts towards the Beezley Hills Rock Island Dam, and Wenatchee Mountains. In a vague way it forms the border zone of the CP and the Okanogan Highlands (Smith 1978, Fig. 6.2).
HI	Hite fault zone	The Hite fault is the main structure of the border zone between the CP and the eastern Blue Mountains. Towards the NE it becomes indistinct but as a zone seems to trend into LC. Approximate eastern boundary of thin CP crust. Comment: The gravity picture of the junction HI-CLEW is complex.
WM	Wallula Gap-Moses Lake	A prominent belt of steepened gravity gradient. Passes through the eastern limit of Saddle Mountain and Frenchman Hills structures and interferes with LC north of Moses Lake. North of LC there is a belt of rather irregular structures in the CR basalts that trends into the Republic graben of the Okanogan Highlands. The belt is 20 to 30 km wide and composed of several strands, the western of which coincides with the east-end of Gable Mountain, and an axial decay of Saddle Mountains, Frenchman Hills and Beezley Hills.
EK	East Kittitas	A structural belt between the Kittitas Valley and the Columbia River, coincides with a north-trending belt of steep gravity gradient parallel to WM but opposite in sense. The gravity belt extends south as far as the CR west of Umatilla, and may even interfere with the Blue Mountains farther south. However, it has played no important role in CRB deformation south of CLEW. Structurally, EK is characterized on its western border (Kittitas Valley) by a dextral array of en echelon brachyanticlines and some flexures and smaller faults which extend as far north as the western end of the Eocene Chiwaukum graben (Leavenworth fault). Its eastern border is marked by a dextral array of axial flexures

		of Manastash Ridge, Saddle Mountains, and Frenchman Hills structures, as well as some short fault segments; in the north particularly by the steep Rock Island structure (USGS prof. papers 100, 1978); there it interferes with LC, and one strand heads NNW into the Entiat fault (E-border of Chiwaukum graben). Comments: Seems to be the partly reactivated southern continuation of Chiwaukum graben, compare. The eastern border coincides in part with "Hog Ranch Butte arc" of Mackay.
SO	Shelton-Olympia	A belt of steep gravity gradient bordering on the northeast the Shelton-Olympia high of Danes et al (1965). Crosses the southern Puget depression into the Coast Ranges.
SC	South Bend-Chehalis	An EW-trending fault belt affecting marine Mio-Pliocene and coinciding with a pronounced gravity step that limits the Shelton-Olympia high to the south. It joins SO east of Chehalis. From this point eastward the situation is unclear in the Eocene volcanics between the Cowlitz and Nisqually rivers, though an eastward trending gravity step penetrates into the Cascades where it joins apparently discontinuous fault zones W and S of Mount Rainier (WR, RL, HS).
TA	Tacoma	The Tacoma gravity step separates the Kitsap high and the Tacoma low of Dames et al. (1965) and crosses the Puget Sound depression from the Olympic Peninsula into the Cascades where it joints ON and WR.
WR	West Rainier	A north-trending belt of apparently discontinuous faulting that marks the western border of the Cascades E of Tacoma.
RL	Rainier-Lost Horse	Summarizes a broad belt of deformation with SE-trending faults and folds that from S of Mt. Rainier passes through the Goat Rocks area towards the lost Horse plateau where it joins HOOK.

HS	Hood River-Skate Mountain	A belt of N to NNW trending faults and folds joining the Hood River graben at the Columbia River, then passing W of Mount Adams into the faulted region SW of Mt. Rainier where it joins SC and RL. Comments: apparently one of the important young $\pm$ NS trending fault zones of the Cascades.
HOOK	Hood River-Delley Hollow	Western boundary of the Yakima folds which along this trend are deflected in a sinistral sense. NOT mapped as a continuous fault or fault belt but obviously of great kinematic importance for Yakima deformation.
TN	Tieton-Naches	A north-striking belt of discontinuous small faults that connects HOOK (s. of Tieton Reservoir) with CLEW-ON at the Naches River. Comments: apparently one of the Cascadian NS trends but of minor importance.
WJ	Willapa Bay-Mt. Jefferson	A belt of predominantly SE trending faults and topographic lineaments that crosses the Willamette depression near Portland and joins the important NS faults (SI) of the Cascades near Mt. Jefferson. A continuation of sorts of the Brothers fracture zone (BR) that enters SI about 70 km farther south.
TJ	Tygh-John Day	From the Hood River graben at the Columbia River along a SE trending, gravity step through the SE trending W-end of Tygh Ridge towards the John Day River at about Sutton Mtn. and into the John Day fault. Here it enters the maze of distributed faults of BR where the somewhat arbitrary but kinematically useful HA, AW, SS, WS are defined. Comments: postulated for gravimetric and kinematic reasons. The Blue Mountains gravity step is interrupted

		at the John Day River gap. From there to the NW a NW-trending gravity step first passes through Tygh Ridge and then joins HS at the Columbia River. In this area it gets lost in the Cascades gravity picture. This belt has an old history and has been reactivated repeatedly in various ways.
JS	John Day-Snake River	On the Geological Map of the US (1974) a 100 km-wide belt of closely spaced NW trending faults characterizes the NW end of the Snake River depression. It virtually dies out at AW (one of the justifications for choosing this boundary zone), and north of the La Grande depression is continued only by the field of small faults SE of Wallula Gap. JS is its SW border zone, as BL is its NE one.
HB	Hite-Blue Mountains	Northern border zone of intensive La Grande-Baker faulting.
WW	Wallula-Wallowa	A belt including the Wallula and Milton-Freewater faults.

Table 2: Blocks of the IDOL Mosaic.

In order to better describe the kinematic and dynamic position of the Yakima block between the North American and Pacific plates, and within its border zone (Basin and Range province, Juan de Fuca plate), the IDOL block mosaic is defined. The block boundaries are the lineaments and border zones defined in Table 1. Except for the Yakima block (8) and the region immediately adjacent to the north no attempt at detailed modeling is made. They are treated in a generalized way only.

Number/Symbol		Name	Comments
1	SD1	Southwestern domain	Contains most of the Oregon Coast Range and Cascades, and the Basin and Range province south of BR. Treated as a reference domain to better define the relative kinematics of IDOL transform mosaic.
2	AM2	Aldrich-Malheur	Dominated in the north by the pre-Tertiary rocks of the Aldrich-Strawberry domain, in the south by the young Newberry-Snake River volcanic depression. This is evidently a complex block with a complex history; nevertheless, the boundary zones here chosen seem to display more movement than the interior of the block, and to set it off against the surrounding blocks.
3	TI3	Turnbill-Ironside	A disturbed block dominated by north-trending faults which distinguish it from its surroundings.
4	OW4	Owyhee	At the junction of the Steens Mtn. and the Western Snake River belts.
5	IB5	Idaho Batholith	
6	WA6	Wallowa	
7	LB7	La Grande-Baker	NW end of western Snake River depression. Broken internally by closely spaced NW-trending faults. Actually a submosaic of distinctive character, except for the northwestern corner domain N of HB which may be separated as PM7a.

Number/Symbol	Name	Comments
7a PM7a	Pendleton-Milton-Freewater	
8 YA8	Yakima	The focus of this study. The northern half is distinctly characterized by the Yakima folds, the southern half by the broad Blue Ridge structure with its pre-Tertiary rocks and a gravity low characteristic of a "continental crust of normal thickness". This is also borne out by the crustal isopachs. Actual folding and important post-CRB folding and faulting are virtually absent in this southern half which thus is the stable hinterland of the Yakima folds. This is important for kinematic-dynamic modeling. Though geologically heterogeneous, the block is a kinematic unit for post-CRB deformation.
9 OC9	Ochoco	Relatively rigid, with only moderate internal faulting according to the Geological Map of the U.S.
10 CO10	Cowlitz	Clearly heterogeneous as it straddles such separate tectonic domains as the Cascades and the Coast Ranges. These, however, apparently are subduction-related units of secondary importance for transform-mosaic kinematics.
11 GH11	Grays Harbor	
12 OP12	Olympic Peninsula	
13 TA13	Tacoma	
14,15	No name	Small blocks within CO10, accommodating deformation around Mt. St. Helens.
16 MA16	Mt. Adams	
17 MR17	Mt. Rainier	

Number/Symbol	Name	Comments
17a BE17a	Bethel Ridge	Has probably played a somewhat separate role in the detailed kinematics W of HOOK.
19 to 22		Small blocks that are relevant only for the detailed kinematics northeast of CLEW.
23 RI23	Ritzville	The virtually undeformed part of CP south of LC.
24 ND24	Northern Domain	Is considered firmly attached to the North American Plate.

9.1 THE KINEMATICS OF THE IDOL BLOCK MOSAIC (FIGURE 14)

Each of the blocks defined above is treated as a rigid body and given a translational vector T_i. To complete the picture, each should be assigned a rotational vector also; analysis reveals the probability of small clockwise rotations (s. p. 18-19 and Figure 12). These, however, seem complexly distributed, and as rotational kinematics is not as apparent it is left out in view of its minor significance.

The following procedure was chosen. YA8 has been studied in some detail, and its T_i is believed the most reliable. It was used as a starting point. The relative motions across its boundaries were very roughly estimated as to shear, extension, and compression. Proceeding thus from block to block, the vector field shown in Figure 14 was constructed. YA-8 was treated as a single rigid block in Figure 14, whereas in Figure 14?, 15, and 16 only the subcrustal lithosphere is assumed rigid, the crust being detached and deformed (Yakima Ridges; see p. 38, 40).

Here are some arguments and comments about the resulting kinematics.

YA8 is characterized by compressive ridges in its northern half indicative of NNW translations of about 3 km, decreasing northward as shortening is absorbed by each succeeding ridge. For the block boundaries this has varying complications. Along CLEW, the normal component of T_i, or T_n, is absorbed by shortening that is periodically relieved or redistributed by rotation (not considered here). Along HOOK T_n was largely used to push the adjacent block mosaic to the NW. The main effect is right slip along ON with minor shortening across ON.

Turning to the southern boundaries of YA8, they must have permitted transfer of T_i from the adjacent block unless the transport dynamics was frictional coupling with asthenospheric convection below, which looks unreasonable on regional grounds.

Consequently, the T_i of OC9 and LB7, and probably also of AM2, TI3 and OW4 have components in the direction of, and as long as, T_i (YA8) (the total translation of YA8). Furthermore, they have components of relative motion at their boundaries (shear and convergence or divergence) which is estimated by inspection of such maps as the Geological Map of the US (1974) or of Washington Public Power Supply System, 1977, where available. For TJ it consists mostly of dextral shear with probably slight convergence (Tygh Ridge),

for AP it consists of sinistral shear with divergence in an ENE direction. The nature of the component LB7 - YA8 is recognized along HB where most of the extensional faulting of LB7 dies out. However, the transition from compressional tectonics in YA8 to extensional tectonics in LB7 through the intermediate block PM7a requires clockwise rotation of YA8, OC9 and AM2, in addition to the translations shown in Figure 14. The southwestern boundary BF of OC9 and AM2 seems to be one of mainly dextral shear, and T_i (SD1) permits, by shearing along BF, the movement of both OC9 and YA8 in the required direction. The most prominent zone of boundary divergence is across SI and HS - the essentially NS striking graben zone of the Cascades which permits EW extension towards the free boundary in the west (compare also Figure 14a).

Quantitatively, all T_i's except T_i (YA8) are educated guesses based on insufficient information. In reality the quantities may be somewhat larger than shown in the Figure; they need not be in order to give a consistent picture that harmonizes with the small deformations mapped in the area. T_i (SD1) then turns out to be directed to the NW and nearly parallel to IDOL (or BF, WJ, ON, CLEW). IDOL is a kind of megabreccia accommodating dextral shear of about 7 km, distributed over a zone 200 - 400 km wide, or an average shear strain gamma of about 0.02.

As to the average clockwise rotation of YA8 and LB7 around a pivot at the northern tip of YA8, it turns out to be no more than 1/2 degree, corresponding to an extension of 2 km in the northern part of LB7.

The reliability of this attempt at embedding Yakima deformation in the kinematics of a surrounding block mosaic depends on several assumptions which need further study. One difficulty, not sufficiently dealt with, is the 3-dimensional relation between lithospheric and crustal kinematics, compare Figures 14a, 15, and 16.

In Figure 14a this problem is illustrated. According to Figure 16 the master shear of the Yakima folds descends into the deeper lithosphere under the Blue Mountains: this would be the proper location of the northern lithospheric block boundary for Yakima deformation proper. North of it, and disharmoniously underlying the Yakima folds, is another lithospheric block YA-8a, whose NE boundary is CLEW.

The strike of the Yakima ridges gives the direction of relative motion YA-8/YA-8a, but does not contain information on lithospheric motion along CLEW. Assuming on Figure 16f,g

that part of the surface deformation measured in the Yakima gorge is the surficial expression (flower structure) of lithospheric motion along CLEW, the transport vector T_i (YA-8) of Figure 14 may be reinterpreted and modified as composed of two lithospheric vectors T_i (YA-8) and T_i (YA-8a). A modest amount of lithospheric motion parallel to CLEW has been added, which would be insufficient to produce conspicuous transcurrent faults at the surface, being hidden in the overall en echelon fold belt.

The vector field of the block mosaic may then be adjusted to the new T_i (YA-8) (total), Figure 14a. A considerable extension (pull-apart) results across HOOK and WR-HS.

10.1 DYNAMICS OF A BLOCK MOSAIC

Boundary stresses and resulting relative block movements are sensitive to overall boundary conditions which change with time. A complexly wobbling movement is induced which is typical for smaller-scale fault breccias: they often exhibit superposed striations of diverging directions and, in limestones, stylolites and extension cracks that also vary with place and time. Inasmuch as most of CRB deformation seems to have occurred within a small time interval relative to the total and still active B & R movements it is not easy to place it exactly within developmental history of the B & R. For example, the Picture Gorge dykes and associated extensional features reveal a kinematic and dynamic pattern of early B & R tectonics that differed greatly from that of CRB deformation (compare also Eaton, 1979), whereas present-day tectonics as revealed by earthquake distributions and focal mechanisms are different again: a present-day pivot seems to be in the Yellowstone-Helena region. However, earlier block mosaics are never entirely discarded as inherited distributions of material properties always influence stress and strength distributions, and consequently the distribution of potential faulting, to some extent.

Block boundaries tend to interfere with each other during motion, which results in inactivation of old and activation of new boundaries. However, some composite zones of movement by addition of small branch faults that help to overcome local obstacles, may develop some sort of strain softning.

11.1 MAPS OF KINEMATIC DEVELOPMENT IN 8 STAGES (FIGURE 15)

(Compare the cross-sectional development, Figure 16, and the block mosaic IDOL, Figures 14 and 14a).

11.1.1 INITIAL MOVEMENTS AT THE BOUNDARIES OF YAKIMA BLOCK YA-8

Stage 1: CLEW

Between the stress concentrators of the La Grande Gap in the southeast (apex of block near Wallula Gap) and of the Kachess-Naches area (bend in the Paleogene Straight Creek fault system near Cle Elum) the CLEW lineament in the CR basalts is nucleated. It initially consisted of broad and gentle dextral en echelon brachyanticlines (short folds) similar to those shown by Hardin and Lowell (1979, Figure 5A). This belt has a width of 30 - 40 km and represents the base of an inverted triangle of deformation that converges downward, with an apex at a depth of 15 - 20 km (wedge boundaries at 45° for simplicity, compare Figure 5). This point coincides with a mechanically weak zone, or a mechanical discontinuity, near the base of the crust. If interpreted according to the Riedel model (compare p. 6-8) of en echelon belts, the discontinuity marks the level of disharmony between a more concentrated wrench fault in a comparatively competent lithosphere slab below and the distributed (diffuse) deformation in the crust above.

The amount of dextral motion in this initial stage was minute ("incipient" to "early stage wrench fault," Harding and Lowell, 1979, Figure 5): a fraction of the measurable total deformation across CLEW, which is not more than 2 km. Due to this initial break across the Columbia Plateau crust and lithosphere, a mechanical discontinuity (boundary) is created which had not necessarily existed before (it cuts across gravity trends and crustal isopachs) of probably Eocene age, see p. 47-48; there is a possibility, however, of an Oligocene Kachess-Naches-Blue Mountains system that had also followed CLEW. Because of the small displacement, this boundary represents no insurmountable obstacle although it makes itself felt during subsequent deformation.

There are various reasons for postulating such an initial break along CLEW, the foremost being that the Yakima folds all terminate against, or are deflected, or otherwise influenced by CLEW which thus must have an earlier origin. A further argument though less cogent is based on the fact that the Yakima block is part of a lithospheric block mosaic (IDOL) At the northern end of the Basin-Range block mosaic, which affects the entire lithosphere. The boundaries of the lithospheric block YA-8, and particularly CLEW and HOOK, were subject to forces exerted by all the surrounding blocks of the mosaic. Crustal decollement on the other hand, is obviously due to driving forces only at the southern

boundary, the other boundaries playing the role of passive constraints. It would therefore seem reasonable to assume an early development of the lithospheric block boundaries and their obstruction soon after initial motion, probably at the northern tip of the block; this, in turn, increased internal NNW compression to the point of yielding along the weak layer at the base of the crust.

11.1.2 INTERNAL DEFORMATION OF THE YAKIMA BLOCK YA-8

As convergent dextral strike-slip motion along CLEW is increasingly obstructed by interference of other faults (for instance HOOK), 6_N and 6_E (the N and E trending horizontal principal stresses) increase, the latter surpassing 6_V (the vertical principal stress) , in magnitude; this is a situation that develops into a thrusting instability at a higher stress level.

The kinematic and dynamic theory thus presented is; first, formation of the Yakima lithospheric block boundaries, and second, internal deformation of the Yakima block at higher stress levels.

The sequence of events during this second internal compressional deformation is depicted in stages 2 - 8. Deformation is assumed to begin in the south and propagate northward for various reasons (compare Figure 16):

1. The most important factor in the sequence of events described below is that the Blue Mountains part of the Yakima block seems to have been the most stable. This correlates with a change in crustal composition according to geophysics (compare Figures 13 and 17), the material interpretation of which is offered on p. 44-46. It probably acts as an indenter type stress concentrator in the map view as well as in the cross-section view (Figure 16); the northward tapering thick crustal wedge is pressed against the CP crust with its presumably weak base. It would appear reasonable to assume that stresses were highest in the south, and there caused the first thrust fault to form.

2. Yakima folds have a tendency to be convex to the north which again suggests they were formed by indentation-type deformation propagating from the south.

3. Inactivation of CLEW-OWL calls for activation of breaks, permitting block movements towards the free Juan de Fuca plate boundary farther south (compare Figure 14a).

4. The individual Yakima folds seem to emanate from the brachyanticlines of CLEW, and thus to be related to the same mechanical discontinuity, a decollement level at 15 - 20 km depth. Slip area on this decollement layer increases for northerly structures which thus should be more stable and be initiated only after inactivation of the more southerly ones.

Spacing of the Yakima folds, except for Yakima Ridge anticline, is surprisingly regular (25 - 30 km), and this regularity requires an explanation. There are several possibilities or combinations of possible factors, but the most plausible at this time seems their apparent relationship with the broad brachyanticlines of CLEW. It is therefore proposed that as decollement instability at the base of the crust spread to the north, the pre-existing, periodically arranged brachyanticlines on CLEW, compare Harding and Lowell (1979, Figure 5) and Wilcox et.al., (1973, Figure 11), or rather the corresponding deep faults (compare Figure 5), were stress concentrators on the decollement surface from which thrusting spread sideways (similar pre-existing features on HOOK are not evident). The relationship of surface folds and decollement surface is shown in Figures 15 and 16.

Stage 2: Columbia Hills Anticline.

The thrust emanating from the base of the Blue Mountains crust compare profiles Figure 16 surfaces almost directly, without significant decollement, at the Columbia Hills fold. The crustal wedge above the thrust is segmented into sub-blocks, indications of which appear on the tectonic maps, but they are even more striking on detailed topographic and gravity maps which correlate in many ways. The structurally lowest sub-blocks are the Dalles and Umatilla sub-blocks. They are separated by the high Condon-Wasco sub-block which occupies a position immediately north of the John Day River gap in the Blue Mountains gravity structure. The Bouguer anomaly gradient forms a belt along the northern foot of the Blue Mountains beginning south of Wallula Gap (at La Grande Gap), and extending WSW to the John Day River. There it becomes irregular, but reforms as a belt again after a short interval, this time striking NW, and is displaced at Tygh Ridge. These

relations, not analysed in greater detail, suggest slightly increased NNW movement west of the Umatilla sub-block, with increased shortening of the Columbia Hills fold (which north of the Umatilla sub-block has only minor shortening).

The average trend of the Yakima structures, generally, and the Columbia Hills anticline, in particular, demonstrate that the direction of principal shortening was to the NNW. The gravity gradient in the Blue Mountains proper, east of the John Day River, is reasonably parallel to this direction and suggests a cross section as shown in Figure 16. This does not hold for the gradient west of the river, and here a certain amount of dextral strike-slip along with compression should be expected. Tectonic behavior should accordingly be more complex, and this is manifested by the Tygh Ridge structure, which is nested within a kink of the pronounced gravity gradient belt, and faces south: although a compressive structure should be formed at this kink, no simple thrusting relation with deep crustal structure is obvious.

The NW trending gravity belt intersects the anomalies due to the Cascades volcanoes, but structurally seems to end at the Hood River graben. The latest fault movements within the graben seem to be younger than the Yakima folds, but as the gravity belts and the HOOK lineament emanating from it to the northeast have strongly influenced the Yakima folds, they must in some way have existed from the very beginning of Yakima deformation.

The Columbia Hills structure is strikingly segmented by cross-structures, particularly in the west. The narrow width of the fold in the Columbia River gorge north of the Dalles calls for a limited amount of shallow decollement approximately at the base of the basalts as shown in the cross section Figure 16. The dextral displacement of some of the sequences shown, for example, by Newcomb (1970) is thought to be due to later movements affecting the western corner of the Yakima block and is not shown at this stage. However, the changes of vergence NE of the Dalles must be a primary, though local, dextral feature. The sinistral apparent displacement near Goldendale is not understood in detail but lies on a sinistral lineament (Horse Thief Point - Goldendale Lineament, or HOG), which has affected all the Yakima ridges in various ways, though less severely than CLEW or HOOK. It seems that this cross-structure is also an early feature, possibly a sub-block boundary associated with W (NW) stretching (see Figure 14a).

It has been mentioned that the sub-blocks of this stage of movement are reflected in the gravity picture which because of the minute amount of movement (about 500 m north of the Dalles, at most 200 m north of Umatilla) must be an inherited feature: it probably influenced the position and shape of the thrust and consequently the deformation of the hanging wall block.

Considerable irregularities affect the Yakima ridges where they enter CLEW, and this is certainly true for the Columbia Hills fold. At Sillusi Butte, near Umatilla, a S-striking fault, associated with folds, trends toward the Blue Mountains though its fate there is unknown. East of it, the fold seems to split up and also increase its compression. Apparently the easternmost part of the slipped domain, like the Western half, moved a little farther than the Umatilla sub-block.

The increased complexity of CLEW is understandable in view of the pre-existing complications along CLEW.

Stage 3: The Horse Heaven Hills Structure

The Columbia Hills structure was inactivated at a modest level of development; instead the base-crust decollement spread to the north, and a new crustal thrust was nucleated at CLEW and propagated to the WSW. The reasons for this development are open to speculation, and some pertinent conjectures are offered on p. 33.

The hanging wall, or upper plate, of the Horse Heaven Hills thrust again shows subdivision into subblocks which are particularly evident on the topographic maps where domains of different shape and drainage character may be distinguished. However, no sharp fault boundaries have been mapped.

The most prominent irregularities are found: 1) on CLEW, 2) on HOG (or north of the Waco-Condon-subblock of stage 2), and 3) on HOOK.

Stage 4: Toppenish Ridge

Again the Horse Heaven Hills thrust was inactivated after a displacement of no more than 300 m - barely sufficient to make a dent in the gravity picture - and decollement spread another 30 km to the north. Nucleation of Toppenish Ridge on CLEW is somewhat less plausible because HOG here interferes with CLEW, and Toppenish Ridge proper disappears east of HOG to be replaced, after a sinistral offset, by

Snipe Mountain which somehow deteriorates in the wide bulge of CLEW south of the Rattlesnake Hills structure. The corresponding modest compression of no more than 300 m is here somehow absorbed by a distributed network of minute displacements, but is concentrated again to some degree at the small but pronounced faulted fold trending to the NW from the NW corner of the Horse Heaven Hills structure.

Stage 5 Rattlesnake Hills Structure

As the front of crustal decollement approaches the apex of Yakima block, the influence of CLEW and HOOK becomes dominant and a pronouncedly arcuate ridge containing numerous irregularities results. There are multiple subparallel SW-striking features that accompany the western part of Athanum Ridge, which is the western part of the Rattlesnake Hills structure.

At Union Gap the structure enters CLEW. Concomitantly to being superposed on a CLEW bulge, it splits up into a number of substructures. These become extremely entangled where they interfere with HOG in addition to CLEW. There seems to be some question as to how much landsliding affects the northeastern corner of Rattlesnake Hill structure but most of the irregularities seem to be structural. Although the apparent displacement along HOG is dextral, the en echelon wrinkles and apparent drag in the Rattlesnake Hills structure immediately west of HOG are sinistral. As the Rattlesnake Hills structure, like other Yakima folds, are strongly influenced by HOG, this latter must have formed at an earlier stage in this area too. All offsets and drags are apparent as the structure developed irregularities from the very beginning. However, there may have been some slight sinistral movement along HOG which is the most prominent subblock boundary.

The Rattlesnake Hills-Wallula Gap (RAW) trend of brachyanticlines and concomitant small faults was superposed on CLEW, which it roughly parallels, at this stage. It is more external than the eastern borders of Toppenish-Horse Heaven Hills stages which fits into a picture of an expanding area of decollement slip. The narrow brachyanticlines are rooted at a shallow level, and there probably is a more concentrated fault structure below the Yakima basalt. It presumably has a limited strike slip and negligible dip-slip displacement. On the other hand, as the whole structure is rooted at a deeper level, the base-crust decollement, reactivation, and accentuation of the broad

CLEW warps occurred simultaneously, resulting in the superposition of the narrow RAW on an accentuated, broad CLEW segment.

Stage 6: Yakima Ridge

Yakima Ridge is virtually superposed along its entire length on HOOK and CLEW. Cowiche Mountain-Sedge Ridge on HOOK strikes SW and is immediately adjacent to the west end of Ahtanum Ridge, separated only by a very straight feature along the South Fork of Ahtanum Creek. Yakima Ridge is first interfered with by an appendage of CLEW at the southeast trending east end of Cowiche Mountain. East of Yakima, the ridge enters the main CLEW bulge, enhancing CLEW and breaking it into weakly defined sub-blocks. The east end of Yakima Ridge splits up into a series of east-plunging, narrow en echelon ridges. There is no pronounced obvious eastern border of the slipped area as there is for Rattlesnake Hills, and it seems likely that the eastern border is a broadly distributed zone of deformation further heightening the CLEW warps and possibly becoming in places more concentrated on joining RAW. On the other hand, it is abundantly clear for this stage as well as the following ones that there is a lack of compression across the lateral boundaries (compare p. 18 and 19). For the CLEW slight clockwise rotation has probably reduced compression, but this rotation increases compression on HOOK unless blocks MA-16 and MR-17 simultaneously move away to the NW (Figure 14a).

Stage 7: Umtanum Ridge

At this stage decollement begins to transgress the borders of the Yakima block. Most of it is still limited by CLEW; however, the easternmost part - Gable Mountain-Gable Butte - now affects a small domain NE of CLEW (22 in Figure 14). The eastern edge of the area of decollement is not bounded by an observable structure, and it is assumed that a zone of distributed dextral shear joins the east end of Gable Mountain with CLEW (compare p. 43 and following).

Umtanum Ridge, affected by several vicissitudes, follows CLEW to the northwest beyond the HOOK-CLEW join; it transgresses the borders of Yakima block also in the same direction. It is uncertain how much of this movement now again follows OWL (ON; compare Figure 14); it is possible that at least some of it is bounded on the west by a vague NS-lineament (NI in Figure 14), with a small amount of

extension of the decollement beyond HOOK (17a in Figure 14), similar to the small amount of extension (22) beyond CLEW in the Gable Mountain area.

Southeast of Priest Rapids, Umtanum Ridge interferes with HOG where it leaves CLEW. It seems likely that the Umtanum Ridge feature splits up there, one (reduced) part continuing into the Gable Mountain branch, and the other poorly defined part following CLEW to the southeast. One reason for this assumption is the apparent decrease in shortening across Gable Mountain; another reason is the apparent divergence of movement between the Yakima block and the Gable Mountain subblock. This divergence is obvious regionally and may be due to the fact that the component of T_i (YA-8) normal to CLEW (directed NE) was more important in pushing blocks 18-22 than the total transport vector. This in turn implies simultaneous dextral shearing along CLEW. Stages 8 and following would than not be kinematically independent of State 7.

Stage 7a: Umtanum-Manastash

Umtanum and Manastash Ridges are closely associated and in some places are not easily distinguished as separate kinematic units. Both units are therefore treated simultaneously in Figure 15. Manastash Ridge does not appear to cross the Columbia River, instead joining Umtanum Ridge in some way at Priest Rapids. At the northwest end, northwest of Wenas Valley, it has not been possible to separate the Manastash, Umtanum and Cleman Mountain features.

Using this information it would appear that decollement affected all these structures nearly simultaneously, but in a highly uneven way because of the pre-existing irregularities of CLEW, which here interferes with HOOK and HOG. Another possibly important interference is that of CLEW with the East Kittitas belt of Bouguer gravity gradient (EK of Figure 14, see also Figure 24), suggesting crustal inhomogeneities.

This is the most concentrated belt of shortening. It has an estimated 1.5 km of shortening in the Yakima gorge section which is about the same as all the other Yakima ridges taken together. This shortening, according to recent mapping, decreases both towards the Priest Rapids section in the southeast and the Cle Elum section in the northwest. In fact, the first impression is that it is concentrated around the northern tip of the Yakima block. This would require that the Yakima block, at this stage, was further pushed to

the north, creating a comparatively strong frontal shortening, but simultaneously avoiding corresponding shortening at its lateral boundaries (see. p. 38).

Stage 8: Saddle Mountain

The Saddle Mountain stage expands the area of decollement farther beyond CLEW to incorporate particularly domains 19 and 21 of Figure 14. While the situation on both sides of the Columbia river gorge is quite clear and measurable shortening is about 230 m (see p. 17). complications are manifest in the East Kittitas zone (EK of Figure 14) in the W and WM (Figure 14) in the E. Distributed dextral shearing is implied in both WM and EK, accentuated in the latter by a series of dextral en echelon brachyanticlines (see p. 17).

A part of the Stage 8 movements to enter the Wenatchee Mountains, beyond the simplified domain shown in Figure 16. At Boylston, one of the branch ridges is deflected to the SW and this is taken to suggest a quantitatively insignificant branch of Stage 8 motion that joins HOOK via SE end of Cleman Mountain.

Further stages of propagation of decollement to the N could be added (see Figure 14a) but they are insignificant kinematically. However, according to the model they are the youngest and may therefore be the seismically most active ones today.

11.1.3 SUMMARY OF IMPORTANT POINTS IN THE MAP-VIEW KINEMATICS OF THE COLUMBIA PLATEAU

1. <u>Distribution of compression:</u>

   Distribution of shortening away from some comparatively rigid indenter is commonplace in tectonics. On a small scale, I have investigated the phenomenon in the Jura (Laubscher, 1980). On a continental scale compare Molnar & Tapponnier (1975). Shortening was comparatively concentrated at the tip of block YA-8a during Stage 7-7a ("Wymer Knot").

2. <u>Lateral extenstion:</u>

   At no stage compression at the lateral boundaries is commensurate with NNW translation. This implies lateral stretching.

3. Clockwise rotations:

Particularly Stages 6 and 7 show a decrease of shortening eastward, implying a slight clockwise rotation.

12.1 DEVELOPMENT OF THE YAKIMA FOLD SYSTEM, CORSS-SECTIONS (FIGURE 16)

Mapped deformation, the Bouguer gravity map and the regional crustal isopachs (Smith, 1978) are combined for a schematic model of deep deformation (for the development of mechanical conditions at depth see p. 51).

Mapped deformation suggests three levels of localized to regional decollement and decoupling which are supposed to be connected by ramps. Gravity and crustal isopachs in turn suggest these to be:

1. The base of lithosphere (sub-Moho velocities here 8.1), perhaps at 50 - 60 km depth. The thickness of the lithosphere may here be somewhat reduced because of the particular setting of CP in a domain of Eocene to Miocene extension.

2. The basal part of CP crust, appx. 20 km. The mantle V_p of 8.1 km/sec suggests peridotite and at a depth of 20 km this could be serpentinized. With a thermal gradient of 25° C/km, the rocks at a depth of 20 km would be in the transition zone serpentinite-peridotite plus water where frictional heat, e.g., could produce a layer of high pore pressure propagating with decollement.

3. The Yakima ridges are relatively narrow wrinkles superposed on wider pedestals due to decollement on the second level. The ridges imply localized decollement at depths of 1 - 3 km, probably at the base of the Yakima sequence which is a mechanical discontinuity. Below this discontinuity strata were deformed and broken before the basalts were extruded (p. 48-49); above the discontinuity there is a layered sequence of alternating competent and incompetent beds of surprising regularity.

Stage 1:

The Yakima block moves as a lithospheric plate, probably part of a primary IDOL (Figure 14). The underlying

reasoning is presented on p. 32-34. Some aspects of this stage that are particularly relevant for the cross-section are:

- zones of dextral shear with a compressional component (dextral-convergent boundaries) commonly develop broad en echelon folds in a deformable layer before faults of noticeable size break to the surface.

- the broad en echelon folds that compose CLEW may be correlated with concentrated dextral shear below 20 km, which would be in the lithosphere.

Consequently, CLEW in this first stage is represented as a "flower structure" typical for en echelon folds (see Figure 5 and Harding & Lowell, 1979): a lithospheric stem (fault) which in the crust branches out into a broad zone of deformation. The branch faults are small and tend to dissipate towards the surface, thus producing broad, apparently unfaulted brachyanticlines.

Stage 2:

The compressive stress level inside the block increases to the breaking point. It is higher in the south towards the active plate boundary. The thicker Blue Mountain crust is stronger than the Yakima crust to the north; the first break therefore emerges as a 30 degrees Mohr-type shear from the northern base of the Blue Mountain crust, probably with a slight amount of decollement at levels 2 and 3. The justification for such a Mohr-type shear is taken from the COCORP results in the Wind River structure (Smithson et al., 1979), and the polygonal shape of the shear surface as a combination of Mohr (ramp) and decollement segments is documented from many parts of the world, e.g., Rich (1934), Rodgers (1949), Charlesworth (1961), Bally et al., (1966), Royse et al., (1975), Roeder and Witherspoon (1978), Laubscher (1973). For nucleation of kink-type near-surface folds see Thompson (1978), Laubscher (1977) (Figure 8 of this report).

Stage 3:

Activation of level-2 decollement proceeds to produce the Horse Heaven fold. The question of why the Columbia Hills fold was inactivated in favor of the more distant Horse Heaven fold is delicate: active and resisting forces on the whole boundary of a potential shearing surface play a role, and as faulting proceeds at a finite velocity, the scenario

is one of three-dimensionally competing rate processes with changing alliances. The tectonic picture suggests the following general reasons:

- near-surface deformation is highly frictional in kink-like folds beyond moderate widths and dips. Thrusts which may be lubricated at depth e.g. by pore pressure are resisted by dry friction at the surface.

- the base-crust decollement should be nearly frictionless if it is to succeed over surface deformation of very modest amounts. The de-serpentinization process as envisaged would fit.

- localized activation of the base-crust decollement zone is already present all along CLEW as suggested by the brachyanticlines. It has a tendency to spread laterally into the Yakima block, there to combine with the northward spreading decollement surface at the base of the crust. Within this mechanism also lies the most plausible explanation for the periodicity and location of the Yakima folds: they are localized by the pre-existing, periodic en echelon folds of CLEW that propagated laterally on top of the nascent base-crust decollement.

For Stages 4 and 5 the same explanation holds.

At stage 6 decollement and folding approaches the north tip of the Yakima block. Here the periodicity breaks down because of the proximity of the block boundary whose influence on the tectonics of the Yakima Ridge is documented by surface mapping.

Stage 7:

Although CLEW is a pre-existing boundary slightly impeding further propagation of base-crust decollement, it is a weak obstacle for two reasons:

- Neither geology nor gravity nor crustal isopachs imply any important change of crustal structure across CLEW. For that reason, it was inferred that CLEW is probably not a discontinuity inherited from pre-Oligocene times but rather a newly formed break connecting distant inherited stress concentrators. Although its formation preceded actual Yakima folding it did so by a geologically minute time interval. A first weak discontinuity may have been formed during the Oligocene Kachess-Naches-Blue Mountains compressional phase (see

Figure 1(a) and p. 32). However, its main development as part of the IDOL system is probably due to Stage 1 of late Miocene Yakima tectonics.

- The base of CP crust is a potential decollement horizon beyond CLEW and was interrupted by a very small amount on CLEW.

Stage 7 represents all the beyond-CLEW stages such as Gable Mountain-Gable Butte, Saddle Mountain, Frenchman Hills, etc.

Near the northern end of the particular cross-section chosen, CLEW approaches the northern border of the Yakima basalts and, simultaneously, the domain of thin CP crust. Further northward spreading of decollement is severely restricted.

The North Kittitas flexure (shown on Figure 15, Stage 8) may, in a way, be similar to the Blue Mountains: a deformation due to the end of crustal decollement. I have symbolically represented it as an underthrust wedge common at the front of decollement plates (Habicht, 1944; Laubscher, 1977; Thompson, 1981; Price, 1981).

13.1 THE DEVELOPMENT OF CRUSTAL STRUCTURE IN THE CP AND ITS INFLUENCE ON THE DYNAMICS OF YAKIMA DEFORMATION AT DEEP LEVELS

13.1.1 A COMPLETE DEFORMATIONAL SYSTEM CAN BE MODELED, EVEN SCHEMATICALLY, ONLY IF VARIATION WITH DEPTH IS INCLUDED

Information placing some constraints on deep structure is contained;

1. in the aspect of surficial structure as explained on p. 12 and following and p. 40-41.

2. in geophysical information on present-day distribution of some rock properties, particularly gravity, seismology, and geothermics.

3. in overall structural history that gives some rationale for placing present crustal structure into a historical perspective, permitting an educated guess about crustal structure at the time of Yakima deformation.

13.1.2 PRESENT-DAY CRUSTAL STRUCTURE IMPLIED BY THE GEOPHYSICAL DATA (COMPARE FIGURES 13, 17)

1. Seismic data

Smith (1978) and Hill (1978) compiled and reviewed much of the seismic information presently available. Directly pertinent for the CP are Figure 7.6 - 7.10 of Hill and Figures 6.2 and 6.3 of Smith.

Figure 6.2 of Smith (compare Figure 13 of this report) shows a crustal thickness of less than 25 km for much of the Columbia Plateau; a corridor of thin crust across the Columbia River structural low in the Cascades, a comparatively steep gradient to a thickness of up to 40 km in the Blue Mountains, and a southeast plunging nose of thick crust (up to more than 50 km) continuing from Vancouver Island across the Juan de Fuca strait and Puget Sound into the Cascades (this particular feature has been challenged by Riddihough, 1979)., This picture must be greatly generalized in view of structural and gravity data, but nevertheless it correlates in a striking if overall way with CP tectonics.

Figure 6.3 of Smith shows that the minimum crustal thickness of the CP coincides with a V_p maximum of 8.1 for the Moho. This in turn implies a comparatively cool upper lithosphere, which correlates with a relative heat flow minimum in the area (Blackwell, 1978; compare p. 49).

Figure 7.6 of Hill gives V_p and earthquake-frequency data for the Puget Sound region which according to Smith's Figure 6.2 is on the 40 km isopach of the Vancouver Island nose. An earthquake frequency minimum at an intermediate depth of about 15 km at a level of lower crustal velocities (6.7 km/sec), and an almost complete cut-off at 30 - 40 km are remarkable. A low-velocity channel at the base of the crust is another feature of possible importance for crustal mechanics in this area.

Although most of the earthquakes occur above 40 km, some earthquakes, including the largest ones, occur to depths of 80 km, in contrast to shallow-focal depths elsewhere in the conterminous US. No clear relation to structures is reported, but it seems

plausible that they correlate with the Vancouver Island crustal nose. However, the structure of Figure 7.6 is not undisputed because it is based on an assumption of plane layers whereas gravity data (Danes and others, 1965; Weston Geophysical, 1979) implies strong lateral variations.

Figure 7.7 of Hill (compare Figure 20 of this report) shows the crustal structure below the central CP (Pasco basin) with, in the center, an upper 10 km layer of 5.2 km/sec (probably sediments and volcanics), then 15 km of Gd km/sec, which is a "granitic velocity", including granitic gneisses. This is the crystalline part of the continental crust, commonly above 30 km thick, here reduced to about 1/2 by a process discussed on p. 49.

In the absence of direct information we may assimilate crustal structure in the Blue Mountains to that given for the western Snake River plain. Figure 17 emphasizes the dramatic changes in crustal composition occurring on the boundaries of the Columbia Plateau.

2. <u>Gravity structure</u>
(New Bouguer anomaly map by Weston Geophysical, 1979).

The extent of the seismically defined CP concides approximately with the domain of moderately negative Bouguer (l.t. -90 mgal) anomalies which in turn approximately coincide with low elevation (and therefore suggest isostatic compensation). The western border zone along HOOK and the Wymer apex of the Yakima block have Bouguer anomalies as low as -100 mgal with an undulating band of steep gradient. Other striking steep gradient belts are along the north slope of the Blue Mountains and, west of the John Day River gap, along the Tygh border - all of which mark zones that seem to have been important for Yakima deformation.

The interior of CP is segmented by a series of more or less pronounced belts of steep gravity gradient. The most striking are the ± NS trending belts between the Kittitas depression and the Columbia River (EK of Figure 14), and farther east between Wallula Gap and Moses Lake (WM of Figure 14). They abut against an EW trending belt ending in the west around Wenatchee (LC of Figure 14).

Superposed on these conspicuous features are less pronounced structures, particularly one trending from the Walla Walla belt east of Wallula Gap, towards the Rattlesnake Hills. This coincides with the RAW part of CLEW.

A somewhat more diffused and patchy belt may be recognized in the NW part of CLEW. Superposed on all these features are weak irregularities which generally produce weak wrinkles in the contours and which coincide with the Yakima ridges - they may even be due to correction techniques - and demonstrate the shallow character and insignificance of these ridges in comparison with total crustal structure.

From these gravity data it would appear that crustal structure tends to change in a stepwise fashion, rather than gradually, from the Central Pasco basin towards the surrounding highlands, a feature reminiscent of foundered crustal blocks with a central deep graben and corresponding crustal thinning (Figure 20; compare Ziegler, 1977, Figure 7, Ramberg and Smithson, 1971, Figure 6). This feature evidently must have developed prior to CRB outpour and most plausibly during the climactic volanic activity in the Eocene (Armstrong, 1978). (Although even older crustal inhomogeneities are implied in the Paleozoic-Mesozoic history of the area, Davis, 1977).

Assigning seismic velocities to rock types is not unique but a plausible picture emerges nonetheless. It may be conjectured that the 5.2 km/sec layer is a volcanic-sedimentary fill in a subsiding graben, and thus is most probably of Eocene age. The Pasco graben strikes north and points to the Republic graben although interrupted and shallowed by the EW striking Wenatchee step (LC). The gravity correlation to structure is somewhat confused not only by the superposition of structures of probably different origin but also by the opposing effects of thickened CRB in the Pasco Basin (positive), thick graben fill (negative) and shallow M (positive) in the graben areas, and will have to be quantitatively modeled for greater certainty (compare the note on p. 50).

Some of the cross-structures modifying or terminating the crustal pull-apart such as the Blue

Ridge or the Wenatchee belt (LC) may have played the role of transform-fault zones bounding and displacing the intra-arc (back-arc?) spreading. Compare this Eocene situation north of the Blue Mountains with the Neogene situation (B & R) south of the Blue Mountains (Pasco Basin similar to Rio Grande Rift; also compare the suggested transform zones with the transform zones of Lawrence, 1976 and Eaton, 1979).

3. Cenozoic Geologic History of the Pacific NW and Crustal Development

The particular crustal structure of the CP, setting it apart from other domains of the North American Cordillera, apparently began in the late Cretaceous (Coney, 1978, page 42). The complex and puzzling set of information that has been published about the Pacific Northwest has engendered a number of sometimes complementary, sometimes conflicting syntheses. In evaluating them I start from the Columbia Plateau and its surroundings, and the vast amounts of detailed information amassed in WPPSS Amendment 23 to the WNP 1/4 PSAR.

A very recent synthesis by Hammond (1979) bears greatly on the problems discussed here. The gist of his thesis is that a Coast Range - Klamath Mountains block (with the Cascade volcanic arc on its back) rifted from the continent along the Olympic-Wallowa Lineament (OWL) and rotated about a pivot in the Olympic Mountains). This rotation supposedly took place between 50 and 15 my bp. Such a large-scale rotation was postulated by Simpson and Cox (1977) on paleomagnetic grounds in the southwestern part of this block, but Beck and Burr (1979) found paleomagnetic evidence for much more modest dextral rotation in the Washington coast ranges and they doubted the rigid rotation postulated by Hammond and Simpson and Cox.

Geological and geophysical evidence in the CP and its surroundings are hard to reconcile with Hammond's rotation. Upper Cretaceous-Eocene continental sedimentation occurred in extensional grabens in pre-Tertiary metamorphic and igneous complexes. These grabens converge towards the N end of the Pasco Basin and have no relation with OWL except at the southwest border of what here is called the Roslyn graben, formed by the Lake

Kachess-Hicks Butte fault system (subsequently compressed in the Naches-Blue Mountains stage not much more than 20 my ago). The Swauk Formation does not transgress this boundary according to recent mapping by Clayton and Miller (1977). Though the environment of sedimentation has been described as a "forearc basin" (Hammond, 1979, page 231), the plate tectonic framework of that time interval is not easily defined in such terms.

This is evident from work of Armstrong (1978) and Coney (1978). Volcanism of that time, the "Challis episode" of Armstrong (see his Figure 12-3) occurs in a belt several hundred kilometers wide, east of the Columbia Plateau. If this wide belt of volcanism is considered an arc, then the grabens north of the Columbia Plateau are intra-arc to back-arc. Armstrong implies that the grabens had once been continuous into the volcanic fields of Idaho, but are now covered by the CR basalts.

Coney (1978, p. 42 and following) provides a plate tectonic frame for this peculiar distributed volcanism. He states that "the simple pattern of a well-defined volcano-plutonic belt of arc affinity along the Pacific margin began to break up in Late Cretaceous time, about the same time that the initial effects of the Laramide orogeny began in the Rocky Mountains foreland" (p. 42). To me this seems a very important tectonic fact: the regional tectonic (and thermo-volcanic) activity was in a state of reorganization during this stage. The prominent event is the development of the Laramide Rocky Mountains, and the grabens of the Columbia Plateau region are in the hinterland of the north end of this eastwards bulging arc. The Late Cretaceous was generally quiet in the Pacific NW, but there was a violent burst of igneous activity in the Eocene.

This general plate tectonic picture harmonizes better with the geological and geophysical information in the CP and its surroundings. Crustal isopachs (Smith, 1978) and detailed gravity (Weston, 1979) fail to support the notion that OWL is the locus of a fundamental change of crustal composition. Although thinning, the crust underlying the CP is non-oceanic, and belts of steep gravity gradient predominantly trend NW and EW without much relation to the trend of OWL.

Comparative anatomy of the CP and similar structures from other parts of the world suggest a different picture.

14.1 A COMPARISON OF SUSPECTED EOCENE CP GRABENS WITH SIMILAR STRUCTURES ELSEWHERE (FIGURES 18 - 20)

The Upper Cretaceous-Eocene grabens present in the region from the Northern Cascades to the Okanogan Highlands are filled with continental deposits containing coal. Though subsequently compressed to some degree, they were, at the time of formation, extensional features that may be compared with other grabens. The trends of the grabens converge toward the Columbia Plateau but it is not known what happens to them below the basalts. A combination of arguments based on geological-historic, tectonic and geophysical data, and a comparison with other grabens is helpful.

Fan-shaped arrangements of smaller grabens are typical at the end of a larger graben. This pattern has been found to hold for many graben structures the world over by H. Cloos (1939). He has shown, moreover, that the main graben is located, at least during initial stages, in the center of a domal uplift, and that its fan-shaped splitting into smaller grabens occurs where it extends beyond the dome. He was able to reproduce this pattern experimentally. It is also plausible on more theoretical grounds (geometry of stress trajectories in ellipsoidal domal uplifts).

The lenticular mass (cushion) uplifting the dome was interpreted to be a magmatic intrusion at the base of the crust, and this picture has been corroborated by later geophysical investigations in many graben areas (e.g. Ramberg and Smithson, 1971; Ziegler, 1977; Ramberg and Spjeldnaes, 1978; Rhinegraben Research Group for Explosion Seismology, 1974; compare also Cook et al., 1979; Seager and Morton, 1978, Figure 7; Keller et al, 1979, Figure 6 for the Rio Grande rift). Under all these grabens the thickness of the crust is reduced by up to 10 km, and the subcrustal mass has physical properties that depend on the age of the rift. These properties correlate with a plausible cooling history of an intrusive mass, and with isostatic subsidence as inferred from the geological record. The latter is particularly complete and well documented for the North Sea rift system because of the search for oil (Ziegler, 1975, 1977, 1978a, 1978b). It demonstrates that where once there had been a dome due to isostatic uplift by a hot intrusive mass, there later developed a basin because of the cooling of this mass under a thinned-out crust. Whereas subcrustal

velocities in active rifts are typically about 7.4 - 7.8 km/sec (compare Smith, 1978, Figure 6-3) they exceed 8 km/s in subsided rift terrains (Ziegler, 1977, Figure 7).

The rifts in the highlands to the north of the Columbia Plateau have been inactive for about 40 my. The subcrustal velocity under the Columbia Plateau is 8.1 km/sec (Smith, 1978, Figure 6-3), and the central part of the Columbia Plateau has a crustal thickness (l.t. 25 km, Smith, 1978, Figure 6-2) that is about 10 km less than that of the surrounding highlands. The central part of the plateau has subsided with respect to sea level by probably more than 2 km since the initiation of rifting.

All these data combined - the geological record, the tectonics implied in the geometry of the grabens, the geophysical configuration and history - fit the model of an Eocene, central graben, now inactive, in the Pasco basin, centered over a region of thin crust.

This concept deserves consideration when interpreting the detailed gravity maps of Weston (1979). The gravity field reflects the superposition of effects arising from anomalous masses at various depths. The geological history and the resulting distribution of anomalous masses are exceedingly complex in the Columbia Plateau and it will not be possible to unambiguously separate all of their contributions to the gravity field. However, it should be noted that bands of steepened gravity gradients like EK and WM resemble that at the western border of the Oslo Graben (Ramberg and Smithson, 1971, Figure 1) which most probably originated at the base of the crust. The width of the belts (approximately 50 km and more) and the gravity step (50 - 90 - mg in the Oslo graben, 20 - 40 mgal for WM and EK) are of the same order. A rough estimate, neglecting all other contributions, shows that a step of less than 5 km in the Moho could produce the correct gravity effect (Nettleton, 1940, pages 112 and following). The width of the Pasco graben measured between mid-points of WM and EK is about 70 km. This is wider than the Rhine graben at the surface (40 km) but less than its low velocity cushion; it also compares well with the Oslo graben at the base of the crust (85 km) and the Rio Grande Rift (e.g. Reilinger et al., 1979; Kelley, 1979, Figure 1).

The southern end of the Pasco graben is the E-W gravity high extending westward through the Columbia River gap in the Cascades. It might have been an Eocene transform zone (sinistral) but speculation is moot at this time. Small branches of a southern graben fan are possibly the La Grande and John Day River gaps in the Blue Mountains gravity belt.*

There are several possible mechanisms for this crustal thinning that are not mutually exclusive. Each mechanism may contribute to the total thinning, but by differing amounts.

*Note: After completion of this report a draft for a report on "Determination of three-dimensional structure of eastern Washington from the joint inversion of gravity and earthquake travel time data" by RODI et al. (1980) was brought to my attention. The authors point out the considerable freedom that exists in selecting a particular model (especially pp. 114 and following). So far as I can see the geological concepts here developed are compatible with the data used by the authors.

1. The crust is certainly stretched in a horizontal direction as established by the well-known normal faults, although by an order of magnitude too small to account for its geophysically established thinning (the models proposed by Lachenbruch and Sass, 1978, for B & R thinning do contribute little to thinning in the Rhine Graben, the North Sea Graben, and the Oslo Graben).

2. Uplift of the dome causes thinning by erosion; but in none of the examples cited and certainly not in the Rhine Graben, can erosion account for more than 1 or 2 km of crustal thinning.

3. Some process of "subcrustal erosion" can also contribute to crustal thinning. The domes are associated with elevated heat flow due to rising magma and this may conceivably lead to elimination of the lower crust, e.g., by stoping when it is still cool and brittle (Laubscher, 1975) or by lateral flow when it is hot and ductile (Sclater et al., 1979, see also Keen and Barrett, 1981). Such a mechanism could account for considerable thinning with modest stretching. Stretching could provide avenues for creeping masses of crystalline peridotite that might "delaminate" the lower crust and form laccoliths at some intermediate crustal level (compare Bird, 1979).

To summarize, the various avenues of reasoning make it appear plausible for the Columbia Plateau that;

1. It has a reduced thickness of continental crust and is not underlain by oceanic crust.

2. The top of the lithosphere (M) is peridotite, and the base of the seismic (not petrological) crust possibly serpentinite.

3. The nature of the crust does not change across OWL, or CLEW, though its thickness increases stepwise particularly along NW and EW trending steps.

4. The basal boundary conditions for the Yakima deformation are

   - a possible incompetent serpentinite layer at the base of the crust for potential decollement and

   - a stepwise changing level of the decollement surface causing stress concentration.

5. The strength of the potential decollement series is greatest where crustal thickness is greatest, i.e., in the frame surrounding CP.

15.1 DEEP STRUCTURE OF YAKIMA DEFORMATION: A COMPARISON OF CLEW WITH THE ANDES OF VENEZUELA (FIGURES 21 - 24)

Similar to CLEW, the Andes of Venezuela are thought to be the result of dextral strike-slip plus a compressional component (Rod, 1956; Schubert and Sifontes, 1970). Both components are on the order of tens of kilometers, perhaps twenty times those postulated for CLEW. A comparison provides some useful insights.

The overall structure of the Venezuelan Andes, based on surface drilling and geophysical data is given by Wittke (in: Bonini et al., 1977), see Figure 21. It shows a crustal thickness of 30 - 35 km. Apart from the faulting, there is a crustal fold consisting of a central high flanked by depressions. Total amplitude is slightly less than 20 km in the north and 10 km in the south (the structure is not quite symmetrical). The high is more pronounced than the lows; the latter amount to about 8 - 11 km in the north, and about 4 - 6 km in the south. The width of the positive raised part of the structure is about 70 km, or twice the crustal thickness, and the flanking depressions are slightly narrower (50 - 60 km, depending on position on the map).

By comparison CLEW (Figure 22) has an overall width of about 40 km, it is flanked by depressions about 30 km wide; however, because these depressions interfere with structures of comparable relief but different origin, their expression is not well defined (compare Figure 24.) The maximum

structural relief on CLEW is about 1400 m positive and 1600 m negative (Bentley, personal communication) or about a tenth to a twentieth that of the Venezuelan Andes, comparable figures considering the relative amounts of movement in the Andes and along CLEW. CLEW should affect about 20 km of crust in comparison with the Andes, as indeed seems to be the case (Figure 23).

Without pushing the comparison too far, I think it supports the interpretation of the kinematics and deep structure of CLEW presented above. In contrast to the Andes, the minute deformation which competes with similar and stronger crustal structures, is barely visible on the detailed gravity map.

16.1 CONCLUSIONS

Yakima deformation may be modeled qualitatively to semi-quantitatively within the conceptual framework of the IDOL (Idaho-Olympic) block mosaic, which is a submosiac of the Basin and Range province. This province in turn is the product of dextral-convergent interaction between the Pacific and North American Plates.

The IDOL submosiac, a NW trending belt, is the northern border zone of the Basin and Range province, and its structures exhibit the results of distributed dextral-convergent shear along its NW strike, slight dextral rotation, and approximately N-S compression (Yakima ridges) an EW extension or pull-apart (particularly Cascades faults, e.g. Hood River graben). This extension suggests decoupling of the Juan de Fuca subduction zone which should be slightly receding to the W in order to accommodate the B & R masses moving westward.

In the development of the Yakima structure three levels of decollement are apparent: asthenosphere, base of reduced crust, and base of Columbia River basalts. A ramp under the Blue Mountains connects the asthenoshpere with the base of CP crust, and shallower ramps branch off the base-crust decollement zone to reach the base of the flood basalts under the Yakima ridges where they produce folding by partial detachment.

The time sequence seems to be:

1. The lithospheric break at the NW-SE trending Cle Elum-Wallula Gap belt (CLEW) with slight dextral convergent displacement and the formation of broad, gentle, periodic en echelon brachyanticlines (NE border zone of Yakima block).

The lithospheric break starting from the Hood River graben in the SW in a northeasterly direction to join CLEW at Cleman Mountain-Kelly Hollow (HOOK). This break is a branch of a general pull-apart zone in the Cascades and is the NW border of the Yakima block.

2. After slight initial motion along its lithospheric boundaries the Yakima block got stuck and internal compression built up to produce the decollement-ramp-fold system of the Yakima ridges, beginning in the south and propagating northward. The first ridges developed within the block boundaries which were used as lateral rails for the decollement sheet; they exhibit the same periodicity as the broad en echelon folds on CLEW and may have been nucleated by them. During later stages decollement spread beyond the block boundaries, guided by Eocene graben tectonics now hidden by the Columbia River basalts. Some motion may still continue today, particularly in the northern folds. The total amount of motion for the last 5 my or so is very small (probably less than 5 km).

The special tectonic behavior of the Columbia Plateau may be correlated with its special crustal structure for which gravity and seismic data combined with regional geologic history suggests an Eocene origin. At that time a graben complex was formed with thermal activity that caused uplift and stretching (thinning) of the crust. After cooling the area subsided, providing the basin for the accumulation of the Yakima basalts. The base of the thin crust may be serpentine which would be suitable for decollement.

17.1 REFERENCES

Angelier, J., and Le Pichon, X., 1980, La Subduction Hellénique et l'expansion égéenne: Reconsitiution Cinématique et Interprétation Dynamique: C. Rapport Sommaire, Societe Géologique de France, Fasc. 5, p. 158-161.

Armstrong, R. L., 1978, Cenozoic Igneous History of the U. S. Cordillera From Latitude 42° to 49°N Latitude, in Smith, R. B. and Eaton, G. P., eds., Cenozoic Tectonics and Regional Geophysics of the Western Cordillera: Geological Society of America Memoir 152, p. 265-282.

Bally, A. W., Gordy, P. L. and Stewart, G. A., 1966, Structure, Seismic Data, and Orogenic Evolution of Southern Canadian Rocky Mountains. Bulletin of Canadian Petroleum Geology, v. 14, p. 337-381.

Beck, Myrtle, Jr. and Burr, C. D., 1979, Paleomagnetism and Tectonic Significance of the Goble Volcanic Series, Southwestern Washington. Geology, v. 7, no. 4, p. 175-179.

Bentley, R. D., 1977, Stratigraphy of the Yakima Basalts and Structural Evolution of the Yakima Ridges in the Western Columbia River Plateau: Guide book, Geological Society of America Annual Meeting, Seattle.

Blackwell, D. D., 1978, Heat flow and Energy Loss in the Western United States, in Smith, R. B. and Eaton, G. P., eds., Cenozoic Tectonics and Regional Geophysics of the Western Cordillera: Geological Society of America Memoir 152, p. 175-208.

Bonini, W., Pimstein de Gaete, C., Graterol, V., 1977, Mapa de Anomalias Gravimétricas de Bouguer de la Parte Norte de Venezuela y areas Vecinas: Republica de Venezuela, Ministerio de Energia y Minas, Direccion de Geologia, Caracas, Scale 1:1,000,000.

Charlesworth, H. A. K., 1961, Some observations on Deformation, Crustal Shortening, and Uplift in the Canadian Rocky Mountains. Journal of the Alberta Society of Petroleum Geologists, v. 9, p. 225-.

Clayton, D. N., and Miller, R., 1977, Geologic Studies of the Southern Continuation of the Straight Creek Fault, Snoqualmie Area, Washington. Shannon and Wilson, Inc.

Cloos, H., 1939, Hebung - Spaltung - Vulkanismus: Geologische Rundschau, v. XXX, Zwischenheft 4A, Ferdinand Enke Verlag, Stuttgart.

Coney, P. J., 1978, Mesozoic - Cenozoic Cordilleran Plate Tectonics, in Smith, R. B. and Eaton, G. P., eds., Cenozoic Tectonics and Regional Geophysics of the Western Cordillera: Geological Society of America Memoir 152, p. 33-50.

Cook, F. A., McCullar, D. B., Decker, E. R., Smithson, S. B., 1979, Crustal Structure and Evolution of the Southern Rio Grande rift, in Riecker, R. E., ed., Rio Grande Rift: Tectonics and Magmatism: American Geophysical Union, Washington, D.C., p. 195-208.

Danes, Z. F., Bonno, M., Brau, E., Gilham, W. D., Hoffman, T. F., Johansen, D., Jones, M. H., Malfait, B., Masten, J., and Teague, G. O., 1965, Geophysical Investigation of the Southern Puget Sound Area, Washington. Journal of Geophysical Research, v. 70, no. 22, p. 5573-5580.

Davis, G. A., 1977, Tectonic Evolution of the Pacific Northwest, Precambrian to Present. WNP-1/4 Preliminary Safety Analysis Report, Amendment 23, Vol. 2A, Subappendix 2RC.

Davis, G. A., Monger, J. W. H., and Burchfiel, B. C., 1978, Mesozoic Construction of the Cordilleran "collage", Central British Columbia to Central California, in Howell, D. G. and McDougall, K. A., eds., Mesozoic Paleogeography of the Western United States: Society of Economic Paleontologists and Mineralogists, Pacific Section, Pacific Coast Paleogeography Symposium no. 2, p. 1-32.

Eaton, G. P., 1979, A Plate-Tectonic Model for Late Cenozoic Crustal Spreading in the Western United States, in Riecker, R. E., ed., Rio Grande Rift: Tectonics and Magmatism: American Geophysical Union, Washington D.C., p. 7-32.

Emmons, R. C., 1969, Strike-slip Rupture Patterns in Sand Models, Tectonophysics, v. 7, no. 1, p. 71-87.

Habicht, K., 1945, Geologische Untersuchungen im Sudlichen Sanktgallisch-appenzellischen Molassegebiet: Beitrage Zur Geologischen Karte der Schweiz, Neue Folge 83.

Hammond, P. E., 1979, A Tectonic Model for Evolution of the Cascade Range, in Amentrout, J. M., Cole, M. R. and Ter Best, Harry, Jr., Cenozoic Paleogeography of the Western United States: Society of Economic Paleontologists and Mineralogists, Pacific Section, Pacific Coast Paleogeography Symposium no. 3, p. 219-237.

Harding, T. P., 1973, Newport-Inglewood Trend, California - An Example of Wrenching Style of Deformation: American Association of Petroleum Geologists Bulletin, v. 57, no. 11, p. 97-116.

Harding, T. P. and Lowell, J. D., 1979, Structure Styles, Their Plate-tectonics Habitats, and Hydrocarbon Traps in Petroleum Provinces: American Association of Petroleum Geologists Bulletin, v. 63, no. 7, p. 1016-1058.

Hildebrand-Mittlefehldt, N., 1979, Deformation Near a Fault Termination, Part I: a Fault in a Day Experiment: Tectonophysics, v. 57, p. 131-150.

Hill, D. P., 1978, Sesimic Evidence for the Structure and Cenozoic Tectonics of the Pacific Coast States, in Smith R. B. and Eaton, G. P., eds., Cenozoic Tectonics and Regional Geophysics of the Western Cordillera: Geological Society of America Memoir 152, p. 145-174.

Keen, C. E. and Barrett, D. L., 1981, Thinned and Subsided Continental Crust on the Rifted Margin of Eastern Canada: Crustal Structure, Thermal Evolution and Subsidence History: Geophysical Journal of the Royal Astronomical Society, v. 65, no. 2, p. 443-466.

Keller, G. R., Braile, L. W., and Schlue, J. W., 1979, Regional Crustal Structure of the Rio Grande Rift From Surface Wave Dispersion Measurements, in Riecker, R. E., ed., Rio Grande Rift: Tectonics and Magmatism: American Geophysical Union, Washington, D.C., p. 115-126.

Kelley, V. C., 1979, Tectonics, Middle Rio Grande Rift, New Mexico, in Riecker, R. E., ed., Rio Grande Rift: Tectonics and Magmatism: American Geophysical Union, Washington, D. C., p. 57-70.

Kienle, C. F., Jr., Bentley, R. D., and Anderson, J. L., 1977, Geologic Reconnaissance of the Cle Elum-Wallula Lineament and Related Structures, Shannon & Wilson, Inc.

Lachenbruch, A. H., and Sass, J. H, 1978, Models of an Extending Lithosphere and Heat Flow in the Basin and Range Province, in Smith, R. B. and Eaton, G. P., eds., Cenozoic Tectonics and Regional Geophysics of the Western Cordillera: Geological Society of America Memoir 152, p. 209-250.

Laubsher, H. P., 1965, Ein Kinematisches Modell der Jurafaltung. Eclogae Geologicae Helvetiae, v. 58, no. 1, p. 232-318.

Laubscher, H. P., 1973, Jura Mountains, in De Jong, K. A. and Scholten, R., eds., Gravity and Tectonics: John Wiley & Sons, Inc., New York, N. Y., p. 217-227.

Laubscher, H. P., 1975, Plate Boundaries and Microplates in Alpine History: American Journal of Science, no. 275, p. 856-876.

Laubscher, H. P., 1977, Fold Development in the Jura: Tectonophysics, v. 37, p. 337-362.

Laubscher, H. P., 1981, The 3D Propatation of Décollement in the Jura, in McClay, K. R. and Price, N. J., eds., Thrust and Nappe Tectonics, p. 311-318.

Lawrence, R. D., 1976, Strike-slip Faulting Terminates the Basin and Range Province in Oregon: Geological Society of America Bulletin, v. 87, no. 6, p. 846-850.

McGill, G. E. and Stromquist, A. W., 1979, The Grabens of Canyon Lands National Park, Utah: Geometry, Mechanics and Kinematics.

Newcomb, R. C., 1970, Tectonic Structure of the Main Part of the Basalt of the Columbia River Group, Washington, Oregon, and Idaho: U. S. Geological Survey Miscellaneous Investigations Map I-587, Scale 1:500,000.

Nettleton, L. L., 1940, Geophysical Prospecting for Oil, McGraw-Hill Book Co., Inc., New York, N. Y., 444 p.

Paterson, M. S., and Weiss, L. E., 1966, Experimental Deformation and Folding in Phyllite: Geological Society of America Bulletin, v. 77, no. 4, p. 343-374.

Price, R. A., 1979, Intracontinental Ductile Crustal Spreading Linking the Fraser River and Northern Rocky Mountain Trench Transform Fault Zones, South-central British Columbia and Northeast Washington: Geological Society of America Abstracts with Programs, v. 11, no. 7, p. 499.

Price, R. A., 1981, The Cordilleran Foreland Thrust and Fold Belt in the Southern Canadian Rocky Mountains, in McClay, K. R. and Price, N. R., Eds., 1981, Thrust and Nappe Tectonics, p. 427-448.

Raisz, E., 1945, The Olympic-Wallowa lineament: American Journal of Science, v. 243-A, p. 479-485.

Ramberg, I. B., and Smithson, S. B., 1971, Gravity Interpretation of the Southern Oslo Graben and Adjacent Precambrian Rocks, Norway, Tectonophysics, v. 11, p. 419-431.

Ramberg, I. B., and Spjeldnaes, N., 1978, The Tectonic History of the Oslo Region, in Ramberg, I. B. and Neumann, E. R., eds., Tectonics and Geophysics of Continental Rifts: NATO Advanced Study Institutes Series, Series C, v. 37, D. Reidel Publishers, Dordrecht, Holland/Hingham, Mass., p. 167.

Reilinger, R. E., Brown, L. D., and Oliver, J. E., 1979, Recent Vertical Crustal Movements from Leveling Observations in the Vicinity of the Rio Grande Rift, in Riecker, R. E., ed., Rio Grande Rift: Tectonics and Magmatism: American Geophysical Union, Washington, D.C., p. 223-236.

Rich, J. L., 1943, Mechanics of Low-angle Overthrust Faulting as Illustrated by Cumberland Thrust-block, Kentucky and Tennessee: American Association of Petroleum Geologists Bulletin, v. 18, p. 1584-1590.

Riddihough, R. P., 1978, The Juan de Fuca Plate: American Geophysical Union Transactions v. 59, no. 9, p. 836-842.

Robyn, T. L., 1977, Geology and Petrology of the Strawberry Volcanics, NE Oregon: Ph.D. Dissertation, University of Oregon, 197 p.

Rod, E., 1956, Strike-slip Faults of Northern Venezuela: American Association of Petroleum Geologists Bulletin, v. 40, p. 457-476.

Rodgers, J. D., 1949, Evolution of Thought on Structure of Middle and Southern Appalachians: American Association of Petroleum Geologists Bulletin, v. 33, p. 1643-1654.

Rodi, W. L., Jordan, T. H., Masso, J. F., and Savino, J. M. 1980, Determination of Three-dimensional Structure of Eastern Washington From Joint Inversion of Gravity and Earthquake Travel Time Data. Report submitted to Weston Geophysical Corporation, Systems, Science and Software Project no. 44094.

Roeder, D., and Witherspoon, W. D., 1978, Palinspastic Map of East Tennessee: American Journal of Science, v. 278, p. 543-550.

Royse, F., Jr., Warner, M. A., and Reese, D. L., 1975, Thrust Belt Structural Geometry and Related Stratigraphic Problems, Wyoming-Idaho-Northern Utah, in Bolyard, D. W., ed., Symposium on Deep Drilling in the Central Rocky Mountains: Rocky Mountain Association of Geologists, p. 41-54.

Schubert, C., and Sifontes, R. C., 1979, Bocano Fault, Venezulan Andes, Evidence of Post-glacial Movement: Science. v. 170, p. 66-69.

Sclater, J. G., and Christie, P. A. F., 1980, Continental Stretching: an Explanation of the Post-mid-Cretaceous Subsidence of the Central North Sea Basin: Journal of Geophysical Research, v. 85, no. B7, p. 3711-3739.

Seager, W. R., and Morgan, P., 1979, Rio Grande Rift in Southern New Mexico, West Texas, and Northern Chihuahua, in Riecker, R. E., ed., Rio Grande Rift: Tectonics and Magmatism: American Geophysical Union, Washington, D.C., p. 87-106.

Shannon & Wilson, Inc., 1973, Geologic Studies of Columbia River Basalt Structures and Age of Deformation, The Dalles - Umatilla Region, Washington and Oregon: Report to Portland General Electric Company.

Shannon & Wilson, Inc., 1978, WNP 1/4 Preliminary Geologic Map W-2685-39, for Washington Public Power Supply System.

Simpson, R. W. and Cox, A., 1977, Paleomagnetic Evidence for Tectonic Rotation of the Oregon Coast Range: Geology, v. 5, p. 585-589.

Smith, R. B., 1978, Seismicity, Crustal Structure and Intraplate Tectonics of the Interior of the Western Cordillera, in Smith, R. B. and Eaton, G.P., eds., Cenozoic Tectonics and Regional Geophysics of the Western Cordillera: Geological Society of America Memoir 152, p. 111-144.

Smithson, S. B., Brewer, J. A., Kaufman, S. Oliver, J. E., and Hurich, C. A., 1979, Structure of the Laramide Wind River Uplift, Wyoming, from Cocorp Deep Reflection Data and from Gravity Data: Journal of Geophysical Research, v. 84, no. B11, p. 5955-5972.

The Rhinegraben Research Group for Explosion Seismology, 1974, The 1972 Seismic Refraction Experiment in the Rhinegraben - First Results, in Illes, J. H. and Fuchs, K. eds., Approaches to Taphrogenesis: Inter-Union Commission on Geodynamics, Scientific Report no. 8, p. 122-137.

Thompson, R. I., 1981, The Nature and Significance of Large 'Blind' Thrusts Within the Northern Rocky Mountains of Canada, in McClay, K. R. and Price, N. J., eds., Thrust and Nappe Tectonics, p. 449-462.

U. S. Geol. Survey Professional Paper 1100, Geological Survey Research, 1978, p. 68 & 78.

Washington Public Power Supply System, 1977, WNP 1/4 Preliminary Safety Analysis Report, Amendment 23, Vol. 2B, Subappendix 2RH.

Weston Geophysical Research, Inc., 1979, Compilation and Interpretation of Gravity in the Vicinity of the Hanford Area, Washington and Oregon: Interim report for Washington Public Power Supply System.

Wilcox, R. E., Harding, T. P., and Seely, D. R., 1973, Basic Wrench Tectonics: American Association of Petroleum Geologists Bulletin, v. 57, no. 1, p. 74-96.

Ziegler, P. A., 1975, Geologic Evolution of North Sea and its Tectonic Framework, American Association of Petroleum Geologists Bulletin, v. 59, no. 7, p. 1073-1097.

Ziegler, P. A., 1977, Geology and Hydrocarbon Provinces of the North Sea, Geojournal 1.1, p. 7-32.

Ziegler, P. A., 1978a, North Sea Rift and Basin Development, in Ramberg, I.B. and Neumann, E.R., eds., Tectonics and Geophysics of Continental Rifts: Proceedings of the NATO Advanced Study Institute Paleorift Systems with Emphasis on the Permian Oslo Rift, Oslo, July 27-August 5, 1977, NATO Advanced Study Institute Series C, v. 37, p. 249-277.

Ziegler, P. A., 1978b, North-Western Europe: Tectonics and Basin Development: Geologie en Mijnbouw, v. 54, no. 4, p. 589-626.

TABLE 2.5-O-3

FIGURE CAPTIONS

Figure 1: The Cenozoic kinematics of the Pacific NW, from Eaton (1979). Elements of Columbia Plateau deformation added.

(a) Period 30 - 20 my b.p. (~up Oligocene). Widespread rifting in the south, associated with compressional tectonics and dextral strike-slip in the north: the Straight Creek-Kachess-Naches-Blue Mountains system (added).

(b) Period 20 - 10 my b.p. (Lower and Middle Miocene). Main extensional period of B & R. Extension spreads northward into the Columbia Plateau; feeder dykes for the CR basalts (dotted).

(c) Period 10 - 0 my b.p. Rifting in the B & R continues but main activity is shifted to new zones (e.g. Intermountain Seismic Belt). The pole for dextral rotation and spreading shifts towards the Helena-Yellowstone area.

(d) and (e) Present: If the Rio Grande rift and the Eastern Snake River plain are accepted as "spreading ridges" or sources of material transport, then a rotation pole somewhere in Manitoba results. Masses drifting away from the ridges move to the Pacific Northwest and there are, dependent on the direction of faults, dextrally compressed. In (d) a former model (see Davis, 1977) for Yakima deformation in this context is shown; it resembles the situation of period (a). In (e), the model developed in this report is sketched: the deformation of the Yakima block (Y, dotted) is embedded in a block mosaic that permits matter moving from the spreading centers to the NW to escape laterally upon the decoupled Juan de Fuca (Cascades) subduction zone by distributed dextral shear. As discussed in the report, dextral shear is associated with pull-apart along some block boundaries and compression along others. Although rigid rotation as envisaged in Figure 1 is considered an oversimplifica-

FIGURE CAPTIONS (Continued)

tion, it nevertheless provides an overall kinematic model. Dynamically, the dextral couple driving rotations is attributed to the dextral plate interaction between the Pacific and North American Plates. However, no detailed analysis is given.

Figure 2: Experimental extensional block mosaic, after McGill and Stromquist (1979). Compare Figure 9.

Distributed shear zones bounding the moving mass are shaded. In the Pacific Northwest, space for the westward moving masses may be provided by a receding Juan de Fuca subduction zone. For another example of a receding subduction see Angelier and Le Pichon (1980; the Cretan arc in the Mediterranean).

Figure 3: Elements of rigid block motion, from Laubscher (1965), map view.

This Figure illustrates the essence of material balance in the map view (a) superposition of translation and rotation; (b) translation with dextral shear boundary on the right and an obliquely covergent, or compressive sinistral, or transpressive sinistral boundary on the left. In the Pacific Northwest, the surroundings of the moving block are composed of other moving blocks (block mosaic) instead of being a fixed reference frame as in Figure 3.

Figure 4: Elements of decollement Kinematics, cross-section, from Laubscher (1965).

Material balance for the simple case of plane deformation of a rectangular mass on a basal decollement horizon.

Figure 5: "Flower-structure" in a wrench fault zone, from Harding and Lowell (1979).

An important aspect of this type of deformation is that the faults branching off from the stem tend to terminate blindly in the subsurface, often at places where an interval is split (Msp), with horizons on the two sides of the fault diverging. Kinematically, wedges bounded by the blind thrusts below and bedding parallel slip above are required in order to fill the space provided by the diverging horizons. In three dimensions, the faults are curved and form an anastomosing complex ("reticulation").

FIGURE CAPTIONS (Continued)

Figure 12: A cut-paper kinematic model of rigid-body Yakima tectonics.

The arrow shows the direction of translation. In contrast to Figures 15 and 16 deformation is shown to begin in the north. Amounts of movement exaggerated (about 10 times). (a) Manastash Umtanum: The CLEW boundary is dextral covergent with respect to translation. In order to eliminate shortening at Wallula gap (right margin) small dextral rotations are added. (b) Yakima, (c) Rattlesnake Hills, (d) Toppenish, Horse Heaven and Columbia Hills.

Figure 14: Kinematics of the IDOL block belt.

Heavy arrows are translational vectors with respect to the North American Plate (NA) of idealized rigid blocks comparing the mosaic (scale in YA-8). Dashed arrows are translational vectors of neighboring blocks. Thin lines are difference vectors. The differences cause boundary zone deformations. (a) Starting point is a 3 km NNW translation of YA-8 with respect to NA, and relative motions with respect to NA are crudely estimated. A divergent transport field results with approximately NS shortening, EW extenion, and dextral shear in the western part. The mosaic ought to be refined, but this is not warranted by the data. Improved modifications of this basic pattern would involve rotations of subblocks, individual blocks and block groups (compare Figure 12). (b) As explained in the text, the Yakima folds are believed to be decollement features not involving the lithosphere except south of the Blue Mountains where the fold-thrust-decollement system is belived to ramp through the lithosphere into the asthenosphere. Consequently, the Yakima block is subdivided into a southern lithosperic block YA-8 whose leading edge are the decollement features of the Columbia Plateau, and a northern lithospheric block YA-8a which was not subject to the 3 km NNW translation of YA-8.

Inasmuch as there seems to be some dextral lithosphere motion on CLEW (Figure 15, stage 1), a NW-directed translation of YA-8a is added, and the vectors of the surrounding blocks are adjusted. The amount of dextral lithospheric motion at CLEW is believed not to exceed 2 km in view of the embryonic deformation observed. The difference vectors between YA-8a and the surrounding blocks imply a pull-apart of slightly more than 2 km between HOOK and HS-WR (compare the Hood River graben). It is these pull-apart features that may provide space for the decollement sheet overlying YA-8a to move latterally into.

FIGURE CAPTIONS (Continued)

The cross-hatched boundary zones separate domains of additional 2 km lithospheric NW translation (in the SW) and the groups of blocks not affected by YA-8 compression (YA-8a, MA-16, MR 17, 17a) but instead subjected to pull-apart. This extension across N-S striking faults is characteristic of the Cascades where it provides avenues for magmatic activity: it is more widespread than shown in this simplified model (compare also S I).

The IDOL mosaic is a sub-mosaic (north-western boundary zone) of the BR mosaic and should be adjusted to its constraints. Ths may require modification particularly of the eastern blocks.

Figure 15: Map view of kinematic development in the western Columbia Plateau (Yakima folds).

For each stage structures formed in the preceding stage are shown in blue, new structures in red (including reactivated lateral boundaries). The main folds and faults are outlined in a simplified fashion, zones of steepening by double lines. Structures taken directly from Shannon & Wilson are in black. The writer has tried to coordinate field observations supplied by Shannon & Wilson (not necessarily their map symbols, which are already an interpretation), topographic and geophysical data for a kinematically plausible interpretation.

Figure 21: A deep crustal section through the Venezuelan Andes (Wittke, 1977).

Similarly to subduction zones, the lithosphere is bent down while the crust is arched up. The crustal high is flanked by marginal basins. The structural interpretation by Wittke does not portray the complex pattern of faulting observed at the surface, nor the kinematics inferred on several lines of evidence (compare Figure 23 with "Flower structure" as in Figure 5).

Figure 22: CLEW, simplified as a small-amplitude crustal fold.

The flanking lows are so shallow that they are barely distinguishable on the background of deformations of comparable or greater intensity (compare Figure 24). The down-fold of M is not observable at the present level of seismic information; it would be on the order of the

FIGURE CAPTIONS (Continued)

kilometer, and would be superposed on irregularities of M on the order of 5 - 10 km due to Eocene crustal thinning and subsequent events.

Figure 23: A superposition of Figures 21 and 22.

It illustrates the basic geometrical similarity in spite of differences in scale. Flower structure of faulting in Andean crust added.

Figure 24: CLEW crustal upfold and flanking downfolds.

The Yakima ridges become narrow dams where they cross depressed areas on both sides of CLEW. Although these flanking lows are modest features in an area of complex crustal development, they are nonetheless striking enough to demand an explanation.

918C

BR FILE NUMBER 213A00 0058

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☒ Approved for Fabrication .... A
☐ NOT Approved .... NA
☐ Approved as noted for Fabrication .... AN See Acceptance Note • Para. T.2. of Appendix A. Section 1 B
☐ For Information Only I
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PITTSBURGH - DES MOINES STEEL CO. CONTRACT 16713

WPPSS Nuclear Project No. 2 - Containment Modification

SECTION: B

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OF:

LOG OF REVISIONS

Rev.	Page	Description	Page	Description	Page	Description
A	7	New	8	New		
B	9	New	10	New	11	New

BR FILE NUMBER 213A00 0058

STRESS REPORT

SECTION B

SUPPRESSION CHAMBER CIRCUMFERENTIAL RING STIFFENER DESIGN - EXTERNAL PRESSURE

REV. 0	6/3/77
REV. A	11/29/77
REV. B	1/16/78

BR FILE NUMBER 213A00.0058

PITTSBURGH - DES MOINES STEEL CO.	CONTRACT NO. 12764/16713		FINAL STRESS REPORT	SECTION: B
WPPSS HANFORD NO. 2 CONTAINMENT VESSEL MOD.				SUBSEC:
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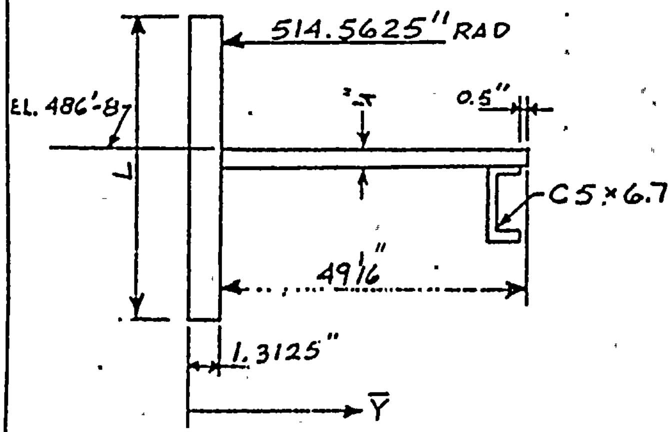
REFER TO PDM DESIGN DWGS: {D-60, D-60A TRANS 903; D-71 " 916; D-50 " 238}

WALKWAY - CIRCUMFERENTIAL RING STIFFENER AT ELEVATION 486'-8"

ACCORDING TO REFERENCE 1, DRAWING S794, THE ELEVATION TO THE PLATFORM T.O.S. IS 486'-8". USING THE RING STIFFENER AS THE FLOOR PLATE, THE STIFFENER WILL BE DESIGNED IN ACCORDANCE WITH REFERENCE 2, ASSUMING ADDITIONAL CIRCUMFERENTIAL STIFFENING AT EL. 516'-6" AND AT EL. 465'-8".



$D_o = 2[514.5 + 1.375] = 1031.75"$

$L_s = \frac{1}{2}[(516'\text{-}6 - 486'\text{-}7\tfrac{7}{8}) + (486'\text{-}7\tfrac{7}{8} - 465'\text{-}8)]$

$L_s = 305.0"$

$A_s = 49.0625(0.25) + 1.97 = 14.24\ in^2$

$T = 1.3125"$

$L = 1.10\sqrt{D_o T} = 40.48"$

AVAILABLE I

$$\bar{Y} = \frac{(40.48)(1.3125)(\frac{1.3125}{2}) + (49\tfrac{1}{16})(0.25)(25.84) + 1.97(48.609)}{(40.48)(1.3125) + (49\tfrac{1}{16})(0.25) + 1.97}$$

$\bar{Y} = 6.64"$

$$I = \tfrac{1}{12}[40.48(1.3125)^3 + 0.25(49.0625)^3] + 0.478 + 40.48(1.3125)(5.98)^2 + 0.25(49.0625)(19.2)^2 + 1.97(41.97)^2$$

$I = 12,360\ in^4$

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CALCULATE MINIMUM REQUIRED I

$$B = \tfrac{3}{4}\left[\frac{P D_o}{T + A_s/L_s}\right] = 2277 \quad \text{FOR 4 psi}$$

FROM FIG. VII-1101-2 OF REF. 2, $A = 0.00015$

$$I_s' = \frac{D_o^2 L_s (T + A_s/L_s) A}{10.9} = 6073\ in^4$$

$12,360\ in^4 > 6073\ in^4$ ∴ STIFFENER IS SATISFACTORY TO CARRY 4 psi EXT. PRESSURE WITH NEW SPACING AND REVISED SHELL STIFFENING AT & BELOW ELEV. 465'-8.

EXTERNAL PRESSURE - EL. 465'-8 TO EL. 486'-8

ACCORDING TO PARAGRAPH 3.4.1.5 OF REF. 1, THE VESSEL IS SUBJECTED TO 4 PSI EXTERNAL PRESSURE. THE FOLLOWING ANALYSIS IS BASED ON PARAGRAPH NE-3133.3 OF REF. 2.

ASSUME CONSERVATIVELY A 1 5/16 SHELL THICKNESS BETWEEN THE WALKWAY AT EL 486'-8 AND THE TOP RING STIFFENER AT EL. 465'-8.

$L = 252.''$

$D_o = 2(514.5 + 1.3) \doteq 1032.''$

$T = 1.25''$ (ACTUAL THICKNESS WITH METAL ALLOWANCE)

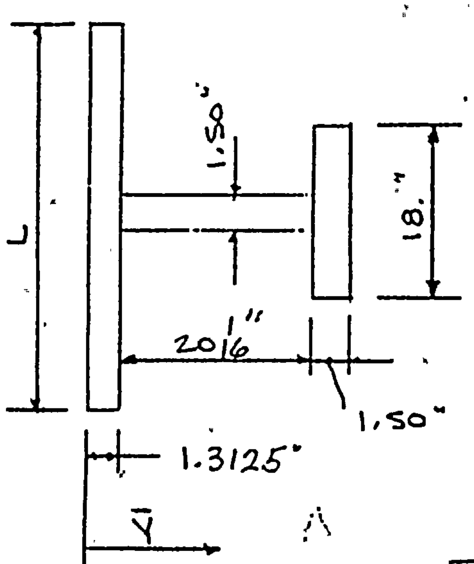
$L/D_o \doteq 0.244$

$D_o/T \doteq 825.0$

FROM FIGURE VII-1100-1 OF REF. 2, $B = 3700$, AND

$$P_a = \frac{4B}{3D_o/T} = 6.0 \text{ PSI} > 4 \text{ PSI} \quad \text{O.K.}$$

CHECK STIFFNESS OF SUPPORT AT EL. 465'-8.



$D_o = 1031.75$

$T = 1.3125$

$L = 1.10\sqrt{D_o T} = 40.48$; USE 38." DUE TO SPACING OF TOP RING

$$\bar{Y} = \frac{(38.)(1.3125)^2/2 + 20.0625(1.5)(11.344) + 18(1.5)(22.125)}{(38.)(1.3125) + (20.0625)(1.5) + 18(1.5)}$$

$= 9.08''$

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$$I = \frac{38.(1.3125)^3 + 1.5(20.0625)^3 + 18(1.5)^3}{12}$$

$+ 38(1.3125)(8.42)^2 + 20.0625(1.5)(2.26)^2$

$+ 18.(1.5)(13.05)^2$

$= 1022 + 3536 + 153 + 4598$

$I = 9309 \text{ in}^4$ SEE ADDITIONAL CALCS. ON LOWER HALF OF PG. 3.

PITTSBURGH - DES MOINES STEEL CO. CONTRACT NO. 12764/16713				FINAL STRESS REPORT	SECTION: B
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EXTERNAL PRESSURE - EL. 465'-8 TO EL. 446'-0

ACCORDING TO REFERENCE 1 & .213A DESIGN SPECS, THE VESSEL IS SUBJECTED TO 19 psi EXTERNAL PRESSURE BETWEEN EL. 465'-8 AND EL. 446'-0. THE FOLLOWING ANALYSIS IS BASED ON PARAGRAPH NE-3133.3 OF REF. 2.

ASSUME A $1\frac{3}{8}''$ SHELL THICKNESS BETWEEN THE STIFFENER RINGS AT EL. 462'-6" AND EL. 459'-4". THE MAXIMUM SPACING BETWEEN ADJACENT STIFFENERS IS 38"; THEREFORE

$L = 38''$

$D_o = 2(514.5625 + 1.3125) = 1031.75''$

$T = 1.3125''$ (ACTUAL SHELL THICKNESS WITH METAL ALLOWANCE)

$L/D_o = 0.037$

$D_o/T = 786.1$

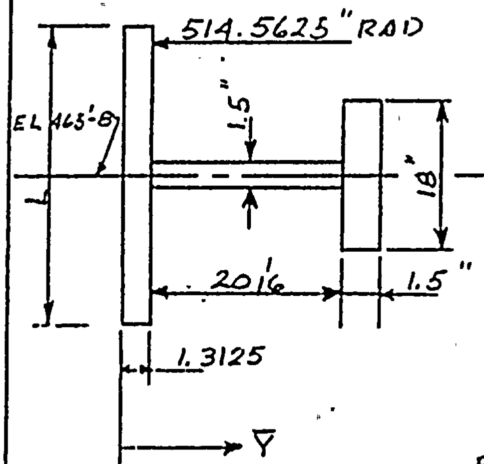
FROM FIGURE VII-1101-2 OF REF. 2

$B = 14{,}000$ AND

$P_A = \dfrac{4B}{3 D_o/T} = 23.7\ psi > 19\ psi$ OK - SHELL IS ADEQUATE AGAINST EXT. PRESSURE BUCKLING

CHECK STIFFNESS OF SUPPORT AT EL. 465'-8

AVAILABLE I = 9309 in⁴ (See Page 2) FOR I Supplied



CALCULATE MINIMUM REQUIRED I:

$L_S = \frac{1}{2}[(486'-7\frac{7}{8} - 465'-8) + (465'-8 - 462'-6)]$

$L_S = 144.9375''$

$A_S = (20\frac{1}{16})(1.5) + (18)(1.5) = 57.09\ in^2$

$D_o = 1031.75''$

$T = 1.3125''$

$B = \frac{3}{4}\left[\dfrac{P D_o}{T + A_s/L_s}\right] = 1814$ FOR 4 psi

FROM FIG VII-1101-2 OF REF 2, A = 0.00013

$I_s' = \dfrac{D_o^2 L_s (T + A_s/L_s) A}{10.9} = 3140\ in^4$

$9309\ in^4 > 3140\ in^4$ ∴ STIFFENER IS OK

PITTSBURGH - DES MOINES STEEL CO. CONTRACT NO. 12764 / 16713 (PDM)	FINAL STRESS REPORT	SECTION: B
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7 RING STIFFENERS FROM ELEV. 446'-0 TO ELEV. 465'-8

THE CENTER LINE ELEVATIONS OF THE SEVEN RING STIFFENERS ARE 447'-8, 450'-6, 453'-6, 456'-6½, 459'-4, 462'-6 AND 465'-8.
THE FOLLOWING ANALYSIS IS BASED ON PARAGRAPH NE-3133.5 OF REFERENCE 2.

CHECK THE MINIMUM MOMENT OF INERTIA SUPPLIED BY ANY ONE OF THE STIFFENER RINGS. A MINIMUM VALUE OF "L" WILL GIVE A MINIMUM VALUE FOR "I".
AT ELEV. 450'-6 : USE T = 1⅜ (1 5/16 WITH METAL ALLOWANCE)

USE $L = 34"$ (MINIMUM L WITH EQUAL LENGTH ON EACH SIDE OF T)

$D_o = 2(514.5 + 1.375) = 1031.75"$

$T = 1.3125"$

$A_s = 20\tfrac{1}{16}(1.5) + 18(1.5) = 57.09\ in^2$

USE $L_s = 37"$ (However, max. Support Length = 36¼", but 37" will be used).

I SUPPLIED

$$\bar{Y} = \frac{(34.0)(1.3125)^2/2 + (20\tfrac{1}{16})(1.5)(11.344) + (18)(1.5)(22.125)}{(34.0)(1.3125) + (20\tfrac{1}{16})(1.5) + (18)(1.5)}$$

$\bar{Y} = 9.52"$

$$I = \tfrac{1}{12}\left[34.0(1.3125)^3 + 1.5(20\tfrac{1}{16})^3 + 18(1.5)^3\right] + 34(1.3125)(8.86)^2 + 1.5(20\tfrac{1}{16})(1.824)^2 + 18(1.5)(12.605)^2$$

$I = 89.14\ in^4$

CALCULATE MINIMUM REQUIRED I:

$$B = \tfrac{3}{4}\left[\frac{PD_o}{T + A_s/L_s}\right] = 5149 \quad \text{FOR } 19\ psi$$

FROM FIG VII-1101-2 OF REF. 2, A = .00036

$$I_s' = \frac{D_o^2 L_s (T + A_s/L_s) A}{10.9} = 37.15\ in^4$$

$89.14\ in^4 > 37.15\ in^4$ ∴ STIFFENER IS OK TO WITHSTAND 19 psi EXT. PRESSURE

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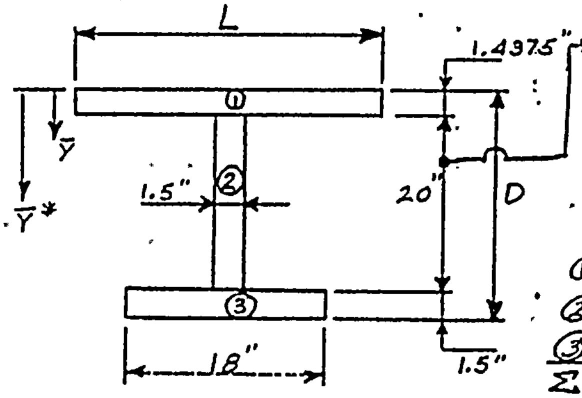
REVISION NUMBER:				

JUSTIFICATION OF ALTERED RING STIFFENERS AT ELEV. 450'-6 & 453'-6

CHECK MOI., A & SECTION MODULUS, S.

PROPERTIES OF ACTUAL SECTION:



(1/16" METAL ALLOWANCE NOT INCLUDED FOR COMPARISON)

USE L = 34"
D = 22.9375"

	A	$\bar{Y}$	$A\bar{y}$
①	48.875	0.71875	35.129
②	30.	11.4375	343.125
③	27.	22.1875	599.0625
Σ	105.875		977.3165

$$\bar{Y}^* = \frac{977.316}{105.875} = 9.23''$$

$$I = \frac{1}{12}\left[(34)(1.4375)^3 + 1.5(20)^3 + 18(1.5)^3\right] + 48.875(8.51)^2 + 30(2.21)^2 + 27(12.96)^2$$

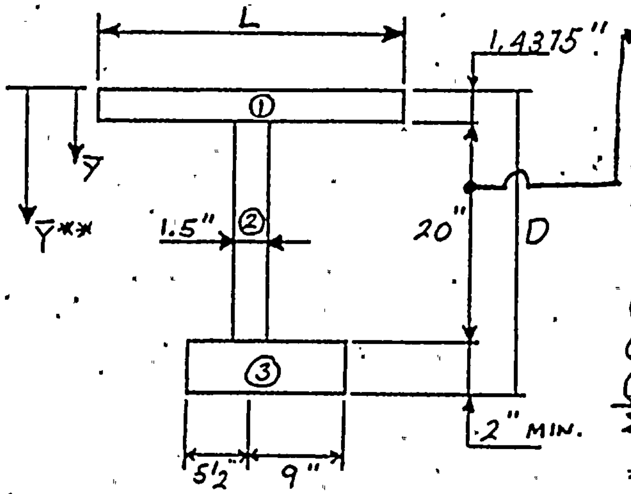
$$I = 9234 \text{ in}^4$$

$$S_{IS} = \frac{I}{D - \bar{Y}^*} = 673.6 \text{ in}^3$$

$$S_{OS} = \frac{I}{\bar{Y}^*} = 1000.4 \text{ in}^3$$

PROPERTIES OF ALTERED RING STIFFENER

ASSUME THE SHELL IS CONTINUOUS & T = 1.4375"



($\frac{1}{16}$" METAL ALLOWANCE NOT INCLUDED FOR COMPARISON)

USE L = 34",
D = 23.4375"

	A	$\bar{Y}$	$A\bar{Y}$
①	48.875	0.71875	35.129
②	30	11.4375	343.125
③	29	22.4375	650.6875
Σ	107.875		1028.9415

$$\bar{Y}^{**} = \frac{1028.941}{107.875} = 9.54"$$

$$I = \tfrac{1}{12}\left[34(1.4375)^3 + 1.5(20)^3 + 14.5(2)^3\right] + 48.875(8.82)^2 + 30(1.90)^2 + 29(12.90)^2$$

$$I = 9754 \text{ in}^4$$

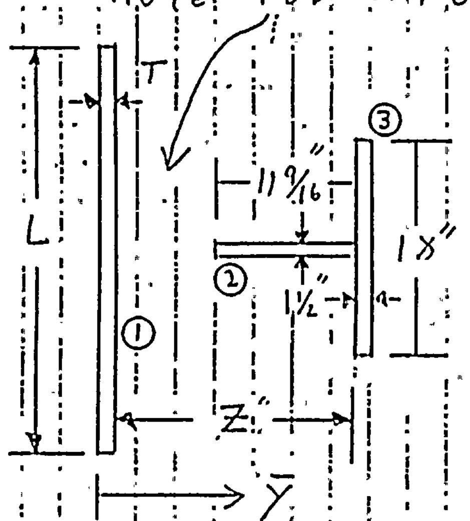
$$S_{IS} = \frac{I}{D - \bar{Y}^{**}} = 701.9 \text{ in}^3$$

$$S_{OS} = \frac{I}{\bar{Y}^{**}} = 1022.4 \text{ in}^4$$

ALL VALUES OF A, MOI AND S ARE GREATER FOR THE ALTERED SECTION THAN FOR THE ACTUAL SECTION. ∴ ALTERED SECTION IS ACCEPTABLE

Moment of Inertia of Ring Girder at Cutout Over WT 8-18

The M.O.I. calculated below are the smallest possible values



For L = 38", T = 1.3125", Z = 20 1/16"

	A	$\bar{Y}$	$A\bar{Y}$
①	49.875	.65625	32.730
②	17.344	15.59375	270.458
③	27.000	22.125	597.375
	94.219		900.563

$$\bar{Y}^* = \frac{900.563}{94.219} = 9.558''$$

$$I = \tfrac{1}{12}\left(38(1.3125)^3 + 1.5(11\tfrac{9}{16})^3 + 18(1.5)^3\right) + 49.875(8.902)^2 + 17.344(6.036)^2 + 27.000(12.567)^2$$

$I = 9{,}054\ in^4$ compared to $9309\ in^4$ on page 2

$9{,}054\ in^4 > 5140\ in^4$ REQ'D, stiffener is O.K.

For L = 34" T = 1.4375 Z = 20"

	A	$\bar{Y}$	$A\bar{Y}$
①	48.875	.71875	35.129
②	17.344	15.65625	271.542
③	27.000	22.18750	599.063
	93.219		905.734

$$\bar{Y}^* = \frac{905.734}{93.219} = 9.716''$$

$$I = \frac{1}{12}\left(34(1.4375)^3 + 1.5(11\tfrac{9}{16})^3 + 18(1.5)^3\right) + 48.875(8.997)^2 + 17.344(5.940)^2 + 27.000(12.472)^2$$

$I = 8975\ in^4$ compared to $9234\ in^4$ on page 5 and: $8975\ in^4 > 3715\ in^4$ REQ'D

∴ is O.K.

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WPPSS NUCLEAR PROJECT NO.2 CONTAINMENT VESSEL MODIFICATION				
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CHECKED BY/DATE:	MWD/1-17-78			PAGE: 9
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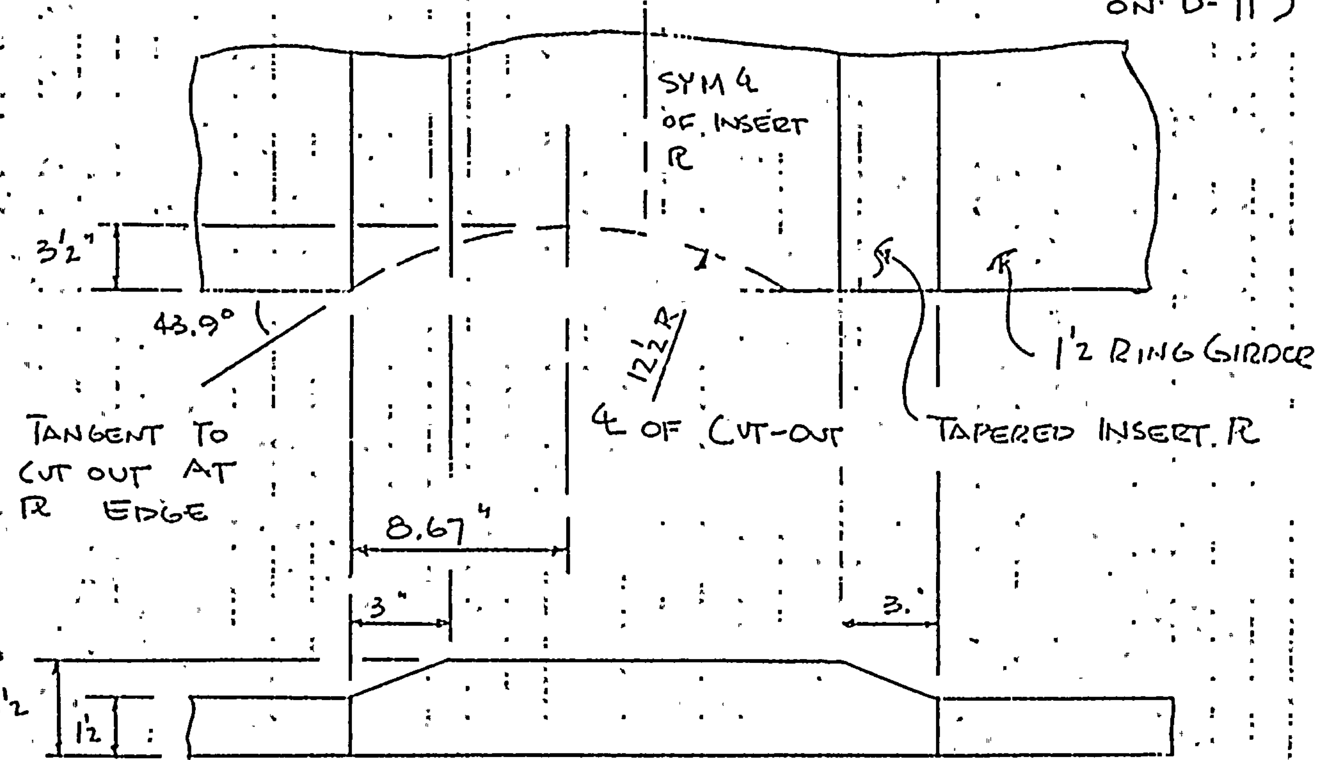
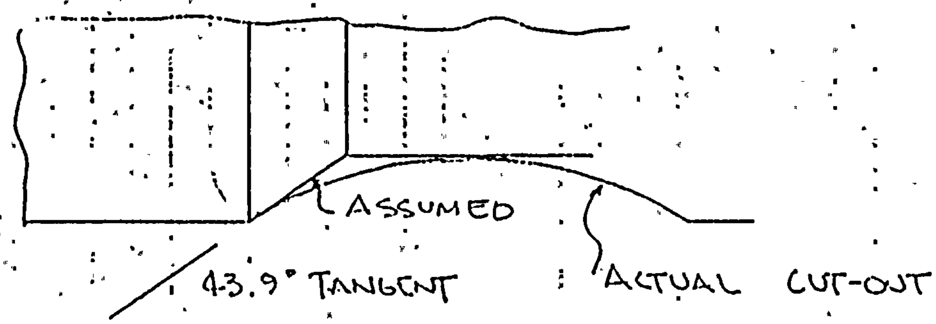
ALLOWABLE HORIZONTAL DISPLACEMENT OF CUT-OUT IN RING GIRDERS @ EL. 450'-6 AND 453'-6 (SEE DETAIL A ON D-71)



CHECK FLANGE AREA IF EDGE OF CUT-OUT IS MOVED TO EXTREME EDGE OF INSERT PL.

CONSERVATIVELY CALCULATE FLANGE AREA ABOVE 43.9° TANGENT LINE



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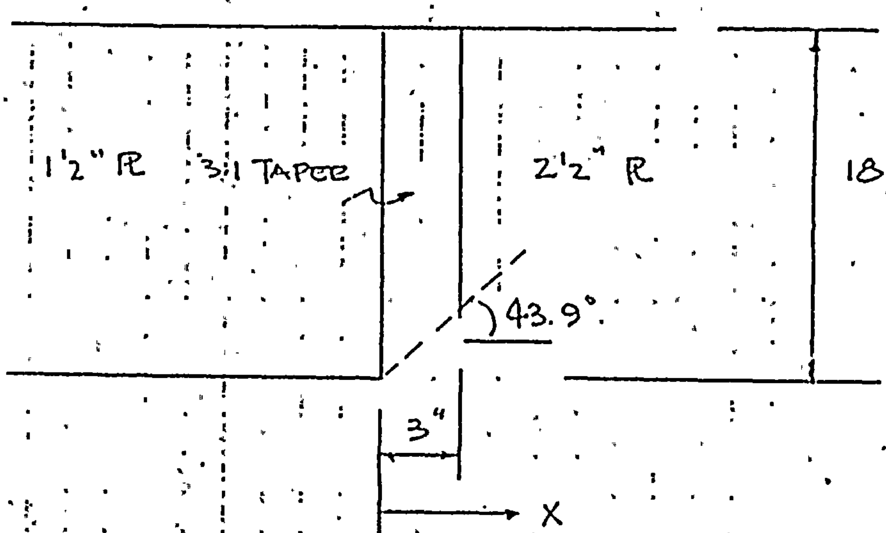
CALCULATE CROSS-SECTIONAL FLANGE AREA IN REDUCED TAPERED REGION ASSUMING CUT-OUT ALONG 43.9° CUT-OUT



FLANGE AREA, A = WIDTH * THICKNESS

$$A = (18. - X \tan 43.9°)(1.5 + \tfrac{1}{3}X)$$

$$A = 27 + 4.56X - .321X^2$$

$$\frac{\partial A}{\partial X} = 4.56 - .321X \quad \text{POSITIVE} \quad 0 \le X \le 3$$

SO A INCREASES IN TAPER REGION ($0 \le X < 3$) AND WILL BE GREATER THAN OR EQUAL TO 27 □" IN CUT-OUT REGION. ∴ CUT-OUT MAY BE MOVED HORIZONTALLY IN EITHER DIRECTION AS LONG AS ENTIRE CUT-OUT FALLS ON THE INSERT R.

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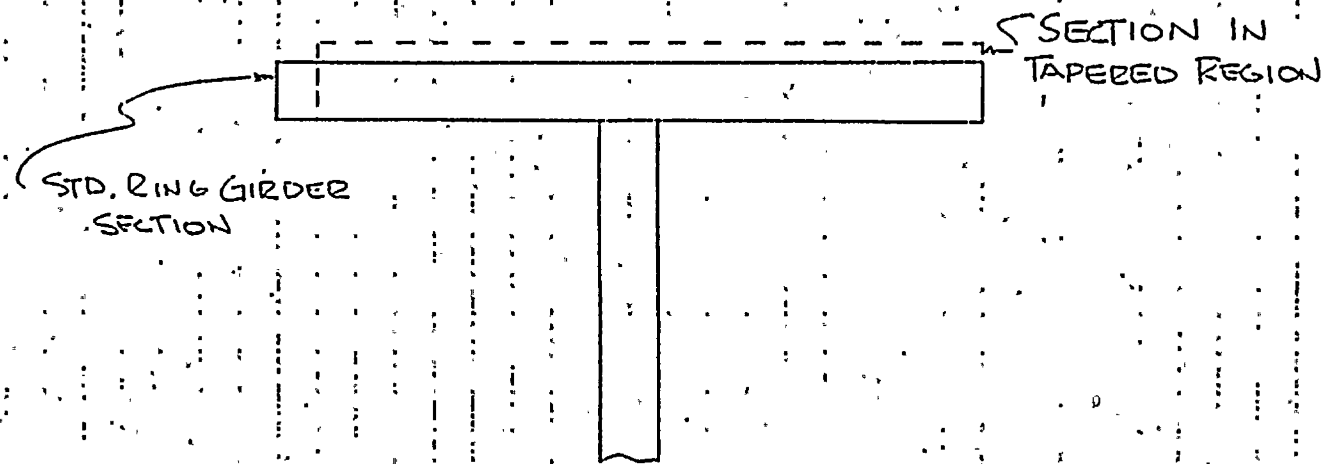
THE RING GIRDER MOMENT OF INERTIA WILL BE GREATER THAN NORMAL IN THE TAPERED SECTION ALSO, FLANGE AREA LOSSED BY REDUCED WIDTH HAS BEEN MADE UP BY ADDING TO THE OUTER FIBER OF THE THICKNESS CREATING A DEEPER SECTION AND HIGHER MOMENT OF INERTIA.



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FINAL DISPOSITION			
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FINAL STRESS REPORT

SECTION II

SUBSECTION 6

REV. A. 6-6-73

REV. B 11-15-73

REV. C 7-5-74

BR FILE NUMBER 213 00 0280

CONTRACT

...ETON PUBLIC POWER SUPPLY SYS.
Hanford No. 2
W. O. 2808

BURNS AND ROE, INC.
... LOS ANGELES, CAL.
... CHECKED BELOW

✓ APPROVED FOR FABRICATION .... A

[ ] ... APPROVED .... NA

...ROVED AS NOTED FOR FABRICATION ...... AN

... AS PRELIMINARY INFORMATION ...... P

... TO ALL CONTRACTUAL PROVISIONS
... ACCEPTANCE OF
MATERIAL OR EQUIPMENT NOT FULFILLING
SPECIFICATION REQUIREMENTS.

PROCESSED BY: [signature] DATE: 9-20-74

DESIGN OF
SUPPRESSION CHAMBER HEAD
AND
INNER SEISMIC SUPPORT SKIRT

THIS SUBSECTION REVIEWED BY: J. F. [signature]

TITLE PROJECT ENGINEER

Introduction:

The following pages contain the design for the Suppression Chamber bottom head, including the applicable design drawings labeled Figures II.6.1, II.6.2, and II.6.3.

The report is divided into four articles. The first article deals with the loading combinations which will be examined in articles 2 and 3. The approach taken here was to eliminate certain "non-critical" design conditions, using either abbreviated calculations or some logical rationale, and base the head design on the four combinations presented on page II.6.1.1.

Article 2 examines the bottom head as if it were buried in concrete from the knuckle-sphere intersection down. This is a conservative design approach in that the knuckle from Elevation 446'-0 down is fixed against movement because the structural T's attached to the shell are buried in the inside concrete. Conservative results are therefore obtained for the knuckle section as well as the support skirt and anchorage system below (See Section II, Subsection 7 of this Final Stress Report). Article 2 also examines the first 3 loading combinations mentioned above, and judges that the head presented in the enclosed figures is adequate.

Article 3 examines loading combination 4, assuming that the head is fixed at Elevation 446'-0. Thermal as well as pressure loadings are applied to the model and the resulting discontinuity stresses at the fixity are examined using an elasto-plastic approach as presented in the ASME Code (Reference 2). Discontinuity stresses produced are judged within their prescribed allowables.

Article 4 examines the inner seismic support skirt and anchorage system for the loadings given on drawing S-794 of the Specification (Reference 1). All stresses are within prescribed allowables, and the support system is judged adequate.

Conclusion:

The bottom head and inner seismic skirt appearing in the enclosed figures satisfies the design considerations prescribed in the Design Specification (Reference 1).

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List of References:

1. Burns and Roe, Inc., Bidding Documents and Plans and Specifications, Specification 2808-213 Primary Containment Vessel Contract No. 213, for WPPSS, Hanford No. 2.

2. ASME, Boiler and Pressure Vessel Code, Section III, "Nuclear Power Plant Components", 1971, including 1972 Summer Addenda, New York

3. AISC, Specification For the Design, Fabrication and Erection of Structural Steel For Buildings, "Manual of Steel Construction", Seventh Edition, New York, 1970

4. ASME, Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels", Division 1, 1971, including 1972 Summer Addenda, New York.

5. Roark, Raymond J., "Formulas For Stress and Strain", Fourth Edition, McGraw-Hill Book Company, New York, 1965

6. ASCE, Transactions, "Paper No. 3269--Wind Forces on Structures", New York, Vol. 126, 1961.

7. Wichman, K. R., et. al., Welding Research Council Bulletin No. 107, "Local Stresses in Spherical and Cylindrical Shells Due to External Loadings", Third Printing, April 1972.

8. Bijlaard, P. P., Welding Research Council Bulletin No. 50, "Additional Data on Stresses in Cylindrical Shells Under Local Loading", May 1959.

9. Blodgett, Omer W., "Design of Welded Structures", The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, 1966.

10. Logcher, R. D. et. al., ICES STRUDL - II Engineering User's Manual, Volume 1, Frame Analysis, Department of Civil Engineering, M. I. T., Cambridge, Mass. R68-91, Novmeber 1968.

11. Logcher, R. D., et. al., ICES STRUDL - II Engineering User's Manual Volume 2, Second Edition, Additional Design and Analysis Facilities, Department of Civil Engineering Research Report R70-77, Massachusetts Institute of Technology, Cambridge, Massachusetts, June 1971.

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List of References: (Cont'd)

12. McDonnell-ECI STRUDL Improvements User's Manual, McDonnell Douglas Automation Company, St. Louis, Missouri, 1972.

13. Winter, George, et. al., "Design of Concrete Structures", Seventh Edition, McGraw-Hill Book Company, New York, 1964.

14. Bijlaard, P. P., "Stresses From Radial Loads and External Moments in Cylindrical Pressure Vessels", supplement to. The Welding Journal, December 1955, p. 608-S to 617-S, 1955.

15. Gaylord, G. H. Jr., and Gaylord, G. N., "Design of Steel Structures", McGraw-Hill Book Company, New York, 1957.

16. The NASTRAN User's Manual, Caleb W. McCormick, Editor NASA SP-222(01), Washington, D.C., June 1972.

17. Timoshenko, S., "Strength of Materials", Part I, Third Edition, D. Van Nostran Co., Inc. Princeton, New Jersey, 1955

18. Timoshenko, S., "Strength of Materials", Part II, Third Edition, D. Van Nostran Co., Inc. Princeton, New Jersey, 1956

19. Bruhn, E. F., "Analysis and Design of Flight Vehicle Structures", Tri-State Offset Co., Cincinnati, Ohio, 1965.

20. Salmon, C. G. and Johnson, J. E., "Steel Structures Design and Behavior", Intex Educational Publishers, Scranton, Pennsylvania, 1972.

21. Brownell, L. E. and Young, E. H., "Process Equipment Design", John Wiley and Sons, Inc., New York, New York, 1959.

LOADING COMBINATIONS:

THE FOLLOWING LOADING COMBINATIONS WILL BE EXAMINED FOR THE DESIGN OF THE BOTTOM HEAD:

1. TENSION DESIGN = 45 PSI + S.C. WATER + ½ SSE E.Q. ACTING VERTICALLY ON WATER (g-FACTOR = 1.2 DOWN) + ½ SSE E.Q. SHEAR (Pg. 178)

2. HOOP COMPRESSION DESIGN = -4 PSI (Pg. 179)

3. LONGITUDINAL COMPRESSION DESIGN = WELDING PAD L.L. + PLATFORM L.L. + VESSEL D.L. + FILLER MATERIAL D.L. + REFUELING BELLOWS LOCA LOAD + FLOOR SEAL LOAD + SSE EQ ACTING VERTICALLY (FACTOR OF 1.45) AND HORIZONTALLY + (-2) PSI + FILLER MATERIAL -2 PSI PRESSURE LOAD + PIPE RUPTURE LOAD (Pg. 180-183)

4. THERMAL + INTERNAL PRESSURE DESIGN (Pg. 76-78)

THESE COMBINATIONS CORRESPOND TO VARIATIONS OF THE INCIPIENT CONDITION APPEARING ON (SPEC.) PAGES 13A-21 & 25 OF REFERENCE 1.

THE OTHER LOADING CONDITIONS WILL NOW BE DISCUSSED AND DETERMINED AS INCONSEQUENTIAL WHEN COMPARED WITH THE ABOVE:

A. PROOF LOAD* TEST CONDITION: THE PROOF LOAD TEST IS A S.C. HEAD STRESS INTENSITY CONDITION WITH A TEST PRESSURE OF 51.8 PSI, DEAD LOADS, S.C. WATER, SMALL E.Q. LOADS,

* SPEC. PARA. 3.4.1.1 OR 3.4.2.1

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AND EMPTY HEADER LOADS. THE ALLOWABLE FOR THIS CONDITION, ACCORDING TO REFERENCE 2, PARAGRAPH NE-6322, IS 0.9 F_y AT TEST TEMPERATURE OR .9 * 38 = 34.2 KSI. IF THE SHELL IS ASSUMED TO BE STRESSED TO 1.0 S_M AND STRESS IS DIRECTLY PROPORTIONAL TO PRESSURE THEN THE STRESS IN THE BOTTOM HEAD IS 51.8 * 1.0 S_M / .45 = 22.2 < 34.2 KSI. THIS CONDITION SHOULD THEREFORE BE SATISFIED BY COMBINATION 1 ABOVE.

B. FINAL PROOF* LOAD TEST CONDITION: THIS CONDITION SHOULD BE SATISFIED BY ONE AND/OR THREE OF THE COMBINATIONS PRESENTED ABOVE.

C. NORMAL OPERATING** CONDITION: SEE B ABOVE (ALSO WITH PIPE WHIP SUPPORT LOADS).

D. REFUELING CONDITION:*** THE REFUELING CONDITION IS A S.C. HEAD COMPRESSIVE CONDITION, WHICH CONSISTS OF THE FOLLOWING:

1. D.L. OF VESSEL AND APPURTENANCES (4389.1 - SEE PAGE II.6.2.180)
2. S.C. WATER
3. PLATFORM LOADS

* SPEC. PARA. 3.4.1.2 OR 3.4.2.2 ; ** SPEC. PARA. 3.4.1.3, 3.4.1.7 OR 3.4.2.3

*** SPEC. PARA. 3.4.1.4 OR 3.4.2.4

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4. FILLER MATL. D.L.

5. ½ SSE E.Q. (VERTICALLY & HORIZONTALLY)

6. WELDING PAD L.L.

7. WATER LOAD OF 23'-6 ON WATER SEAL

8. REFUELING BELLOWS LOAD

9. EXTERNAL PRESSURE OF 2PSI - FILLER MATL.

10. SEAL LOADS

EXAMINING COMBINATIONS 1 AND 2 FROM PAGE II.6.1.1, IT IS SEEN THAT THEY CONTROL OVER THE ABOVE LOADS, FOR LONGITUDINAL COMPRESSION, CALCULATE THE LOADS SPECIFIED BY ITEMS 7 AND 8 ABOVE:

FOR ITEM 7, ASSUME WATER TO ELEVATION 606-10½.

FOR INNER RING, WATER HEIGHT = 606-10½ - 582-8¼ = 24-2¼

FOR A LENGTH FROM 31-8/2 TO 25-6/2. TOTAL LOAD IS THEREFORE:

$$T.L. = \pi\left[(15'-10)^2 - (12'-9)^2\right](24'-2\tfrac{1}{4})(62.4)$$

T.L. = 417887 LBS

THE OUTER BELLOWS LOAD IS -45#/IN, OR (45)(2π)(207)

= 58525 LBS

FOR THE OUTER RING, THE WATER LOAD IS:

$T.L. = \pi[(17-3)^2 - (15'-11\frac{1}{2})^2](26-2\frac{1}{4})(62.4)$

T.L. = 220,204 LBS

THEREFORE, THE TOTAL LOAD FOR ITEMS 7 AND 8 IS 696.6K

THE SUM OF ITEMS 1, 3, 4, 6, 7, 8 AND 9, CALCULATED ON PAGES II.6.2.180 & 181, IS 19976.K WHEN MULTIPLIED BY A VERTICAL G-FACTOR OF 1.23.**** THE SEAL LOADS DURING REFUELING WILL BE ASSUMED THE SAME AS THE NORMAL OPERATING LOAD SPECIFIED ON DRAWING 5799, OR THE TOTAL VERTICAL LOAD IS ABOUT EQUAL TO (2π)(505.5)(50)(1.23) = 195.3. THEREFORE, TOTAL COMPRESSIVE REFUELING LOAD IS 20,171.3K, WHICH IS LESS THAN THAT USED IN DESIGN COMBINATION 3.*

E. INCIDENT CONDITION:** VARIATIONS OF THIS CONDITION LEAD TO THE THREE COMBINATIONS USED FOR THE FINAL ANALYSIS (ALSO WITH PIPE WHIP SUPPORT LOADS).

F. FLOODED CONDITION:*** THE FLOODED CONDITION IS BOTH A LONGITUDINAL COMPRESSION AND HOOP TENSION PROBLEM. THE HOOP TENSION IS CAUSED BY FLOODING TO ELEVATION 581-10½. THE PRESSURE STRESS AT THE TOP OF THE INSIDE CONCRETE

** SPEC. PARA. 3.4.1.5, 3.4.1.6 OR 3.4.2.5
*** SPEC. PARA. 3.4.1.8 OR 3.4.2.6
* SEE PAGE II.6.1.1
**** 1.23 FACTOR APPLIED TO ITEMS 1, 4, 6, 7 & 8

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AT ELEVATION 446-0 FOR THE FLOODED CONDITION IS:

(531.875 - 446.0) 62.4 * 1.2/144 = 70.655 PSI ✓

WHERE 1.2 IS THE VERTICAL E.Q. FACTOR. FOR LONGITUDINAL COMPRESSION IT IS NOT NECESSARY TO GO BELOW THE TOP OF THE INSIDE CONCRETE SINCE BELOW THIS THE VERTICAL SHELL STIFFENERS ARE BONDED TO THE CONCRETE AND BUCKLING CANNOT OCCUR IN THE MERIDIONAL DIRECTION. LONGITUDINAL COMPRESSIVE STRESS AT THIS LOCATION WILL BE CAUSED BY:

1. D.L. = 4389.1K (SEE PAGE II.6.2.180)
2. PLATFORM L.L. = 8488.K
3. FILLER MAT'L D.L. = 87.1K ✓
4. WELDING PAD L.L. = 3000 K ✓
5. WATER LOAD ON SEAL = 220.2 K + 529.5 K**
6. EXTERNAL PRESSURE OF FILLER = 1436.4 K
7. BELLOWS LOAD = 97.5K *

MULTIPLYING 1,3,4,5 AND 7 BY A VERTICAL E.Q. FACTOR OF 1.35, AN AXIAL COMPRESSIVE LOAD OF 21161.K IS OBTAINED. FROM REFERENCE 1, FIGURE 8, THE MAXIMUM OVERTURNING MOMENT AT THE TOP OF THE INSIDE CONCRETE (EL. 446-0)

* ASSUME PLANT SHUTDOWN LOAD OF 75#/IN ON O.S.

** [illegible]

IS 592×10^3 FT-K. THE COMPRESSIVE STRESS, WHICH EQUALS THE SUM OF THE AXIAL STRESS AND BENDING STRESS, IS AS FOLLOWS FOR THE SHELL AT EL. 446-0.

$$\sigma_{AXIAL} = 21161 / 5027.2^* \cos 14.4232$$

$$\sigma_{AXIAL} = 4.346 \text{ ksi}$$ (4.3)

$$\sigma_{BENDING} = 592 \times 10^3 \times 12 * 510.39 / 651.43 \times 10^{6*} * \cos 14.4232$$

$$\sigma_{BENDING} = 5.747 \text{ ksi}$$ (5.7)

$$\sigma_{TOTAL} = 10.093 \text{ ksi}$$ (10.0)

THE MAXIMUM HOOP TENSION WILL OCCUR AT THE BELT SEAM IF THE MODEL PRESENTED IN ARTICLE 3 IS ASSUMED. IF THE MODEL IN ARTICLE 2 IS ASSUMED, THE KNUCKLE GOES INTO HOOP COMPRESSION.

$$\sigma_T = \frac{(581\text{-}10\tfrac{1}{2} - 449\text{-}8\tfrac{1}{2})(62.4) * 1.2 * 515.28125 * 12}{1728 * 1.4375 * 1000}$$

$$\sigma_T = 24.6 \text{ ksi}$$ ✓

* SEE PAGE II.6.2.182 FOR PROPERTIES OF STIFFENED SHELL SECTION

TOTALING THE LONGITUDINAL COMPRESSIVE STRESS AND ADDING IT TO THE HOOP TENSILE STRESS WILL RESULT IN A STRESS INTENSITY, THE VALUE OF WHICH MUST BE LESS THAN

F_y AT 212°F = 34.5 KSI (34.6

STRESS INTENSITY = 24.6 + 10.1 = 34.7 > 34.5 ksi
BUT SAY OK SINCE HOOP TENSION STRESS AT ELEV. 446'-0 IS LESS THAN 24.6 ksi

---

CALCULATIONS FOR WATER ABOVE TOP HEAD:

V_{TOTAL} = VOLUME FROM EL. 606'-10½ TO EL. 590'-9¼ (V_1) MINUS VOLUME OF TOROSPHERICAL HEAD (V_2)

$V_1 = \pi r_1^2 h = (\pi)(190.9375)^2(193.25)/1728 = 12808.79 \text{ FT}^3$

$V_2 = \frac{\pi R^3}{3}(2+\cos^3\beta - 3\cos\beta) + \pi c^2 r\cos\beta + \pi r^2 c \times (\frac{\pi}{2} + \sin\beta\cos\beta - \beta) + \frac{\pi r^3}{3}(3\cos\beta - \cos^3\beta)$

w/ R = 28'-8 15/16 β = 26.5984°
r = 5'-6 3/16 c = 10'-4 3/4

$V_2 = 4322.83 \text{ FT}^3$

$\therefore W_T = \gamma(V_1 - V_2) = 529.5$ kips

AXISYMMETRIC SHELL ANALYSIS

THE FOLLOWING PAGES CONTAIN THE AXISYMMETRIC SHELL ANALYSIS OF THE BOTTOM HEAD USING PDM'S AXISYMMETRIC SHELL PROGRAM AX2 (SEE APPENDIX I, ARTICLE 1 OF THIS FINAL STRESS REPORT) THE LOWER PART OF THE SUPPRESSION CHAMBER CYLINDER IS INCLUDED, UP TO THE MAXIMIUM WATER LEVEL OF 466'-4¾" SHOWN ON DRAWING S794 OF REFERENCE 1, FOR DISCONTINUITY EFFECTS, BUT ITS SPECIFIC DESIGN IS NOT INCLUDED HERE.

THE LOADINGS IMPOSED ON THE MODEL ARE 45psi INTERNAL PRESSURE, SUPPRESSION CHAMBER WATER, AND ½SSE VERTICAL EARTHQUAKE (0.20 'g'-FACTOR DOWN). PRESCRIBED DISPLACEMENTS ARE USED IN THE SPHERICAL SECTION (BELOW NODE NO. 701) TO MODEL CONCRETE SHRINKAGE FROM THE SHELL. FROM WINTER & NILSON (REFERENCE B, PAGE 22), MAXIMIUM VALUES OF FINAL SHRINKAGE FOR ORDINARY CONCRETES ARE GENERALLY OF THE ORDER OF 0.0007 IN/IN. TAKING THE MAXIMIUM CONCRETE POUR TO BE (2) SHOWN ON DRAWING S740 OF REFERENCE 1, THE HEIGHTH OF THIS POUR IS 84.264 (LENGTH OF SKIRT) − 6.0 = 78.264 IN. THE PRESCRIBED DISPLACEMENTS WILL THEN BE 0.0007 * 78.264 = 0.055 IN (ASSUMED NORMAL TO THE SHELL)

THESE PRESCRIBED DISPLACEMENTS WERE USED ONLY FOR THE BOTTOM SPHERICAL DISH WITH ITS 0.8125" CORRODED THICKNESS. ALL BODIES FROM (600) TO AND INCLUDING (402) HAVE ACCEPTABLE MEMBRANE AND EXTREME FIBER STRESSES, SO THIS SECTION OF THE BOTTOM HEAD MUST BE CONSERVATIVE SINCE THE SHELL ACTUALLY RECEIVES SUPPORT FROM THE CONCRETE BEFORE IT REACHES THE FULLY DEFLECTED SHAPE,

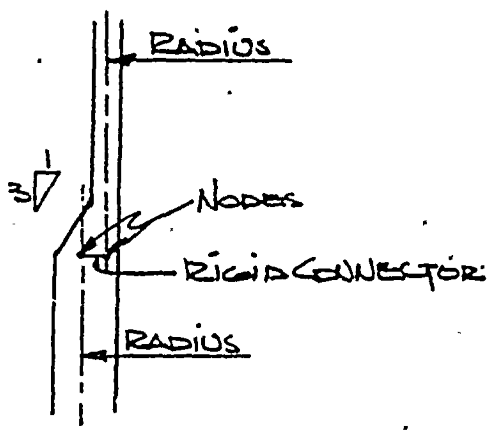
WHICH PRODUCES THE STRESSES SHOWN.

A FEW WORDS SHOULD BE SAID ABOUT THE AX2 MODEL WHICH FOLLOWS:

(1.) THE KNUCKLE OF THE BOTTOM HEAD IS OF A TORUS GEOMETRY, BUT IS MODELED AS A SERIES OF SPHERICAL SEGMENTS. THE DIFFERENCE BETWEEN THE SEGMENT ANALYSIS AND THE TORUS SOLUTION IS NEGLIGIBLE

(2.) A HOLE EXISTS IN THE MIDDLE OF THE SHELL ON THE AX 2 MODEL. THE REASON FOR THIS IS THAT POINT LOADS ON A SHELL ARE NOT ALLOWED IN AX2, AND THIS IS WHAT WOULD RESULT IF A PRESCRIBED DISPLACEMENT WERE PLACED AT THE SPHERE APEX. THE RESULTS FOR THE SPHERICAL HEAD SHOULD, HOWEVER, PROVE SATISFACTORY.

(3.) THE CONNECTION BETWEEN PLATES OF DIFFERENT THICKNESS IS ACCOMPLISHED BY USING AX-2'S RIGID CONNECTOR ELEMENT IN THE FOLLOWING WAY:



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(4.) A PIN CONNECTION IS ASSUMED AT NODE 300, WHICH REPRESENTS THE STUD LOCATION. IT IS FELT THAT THIS BEST EXEMPLIFIES THE JOINT CONDITION AT THIS NODE.

(5.) AS PREVIOUSLY STATED, PRESCRIBED DISPLACEMENTS ARE APPLIED TO THE BOTTOM HEAD NODES. A UNIFORM DISPLACEMENT CANNOT BE PLACED ON THE HEAD, AND LARGER DISPLACEMENTS WILL RESULT BETWEEN SUPPORTED NODES. THIS WILL RESULT IN STRESSES HIGHER THAN THOSE ACTUALLY PRESENT. THEREFORE, THE ANALYSIS SHOULD BE CONSERVATIVE.

(6.) THE PLATE TAPER WAS NOT MODELED AT THE INTERSECTION OF THE 1½" TORUS TO THE 7/8" SPHERICAL HEAD. THIS WOULD HAVE RESULTED IN A BODY 1⅞" LONG BY 7/8" THICK, WHICH IS NOT A THIN SHELL.

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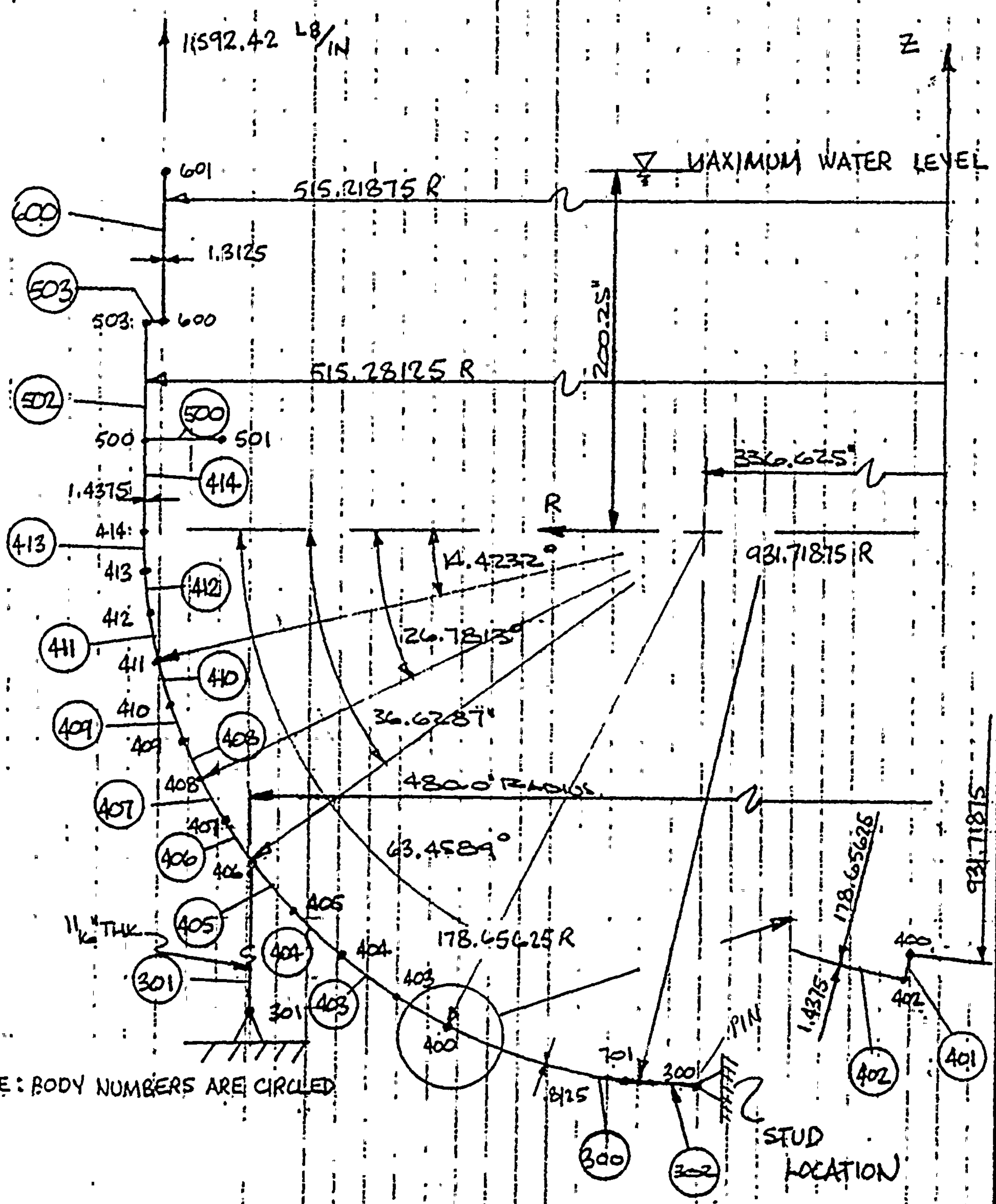
AX2 AXISYMMETRIC ANALYSIS OF BOTTOM HEAD



NOTE: BODY NUMBERS ARE CIRCLED

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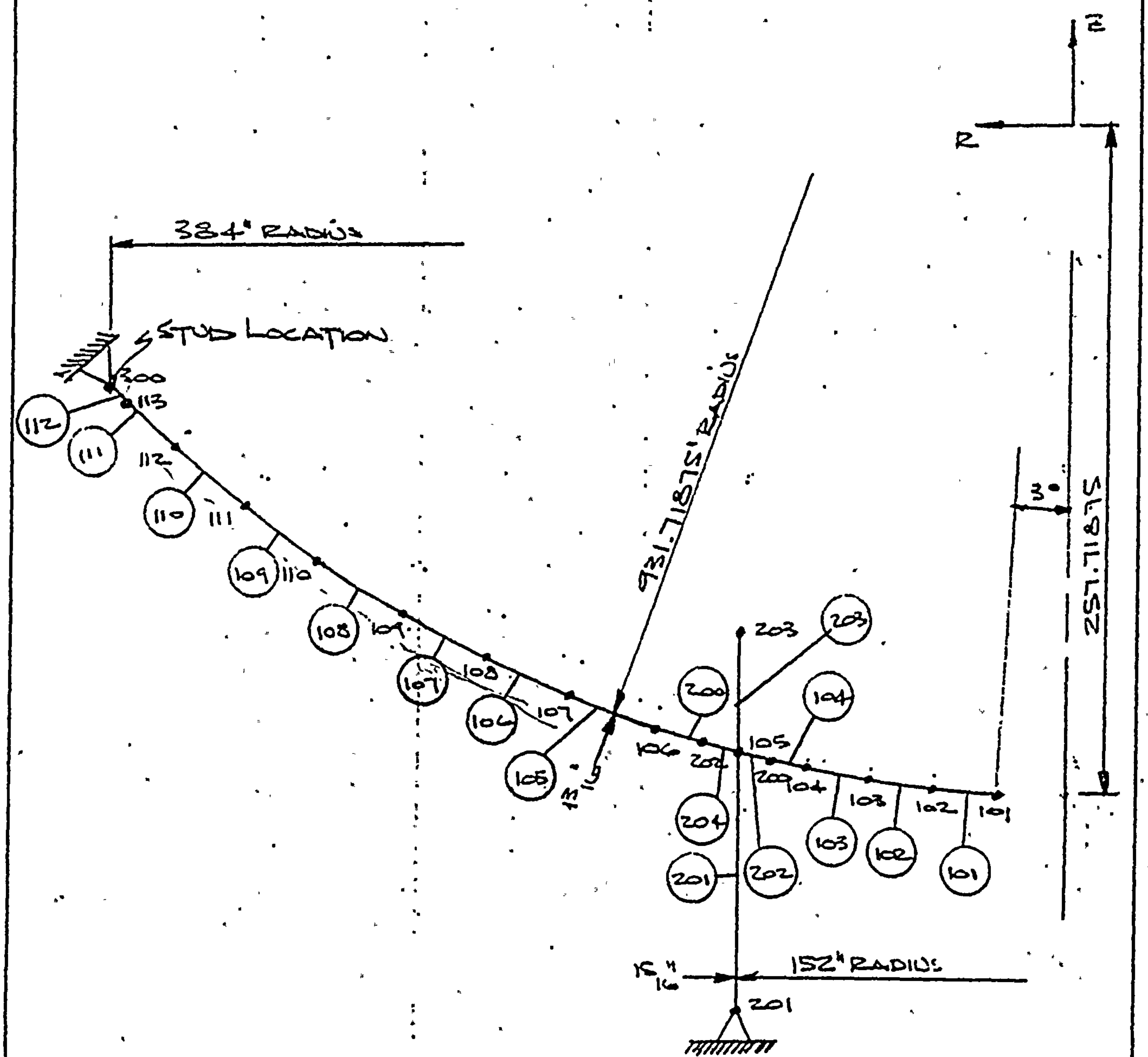

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

NUMBER OF NODES = 39   NUMBER OF BODIES = 38

NODE NO.	COORDINATE R	COORDINATE Z	OBLIQUE AXIS ANGLE	FIXITY CODE
101	0.487636E 02	-0.256442E 03	-0.300000E 01	0
102	0.746808E 02	-0.254721E 03	-0.459700E 01	0
103	0.100540E 03	-0.252278E 03	-0.619500E 01	0
104	0.126321E 03	-0.249116E 03	-0.779200E 01	0
200	0.139174E 03	-0.247266E 03	-0.859100E 01	0
105	0.152000E 03	-0.245236E 03	0.0	0
201	0.152000E 03	-0.329500E 03	0.0	110
203	0.152000E 03	-0.209261E 03	0.0	0
202	0.167108E 03	-0.242611E 03	-0.103320E 02	0
106	0.182170E 03	-0.239736E 03	-0.112750E 02	0
107	0.212135E 03	-0.233248E 03	-0.131610E 02	0
108	0.241871E 03	-0.225777E 03	-0.150470E 02	0
109	0.271345E 03	-0.217331E 03	-0.169310E 02	0
110	0.300525E 03	-0.207921E 03	-0.188170E 02	0
111	0.329380E 03	-0.197555E 03	-0.207030E 02	0
112	0.357878E 03	-0.186246E 03	-0.225880E 02	0
113	0.377500E 03	-0.177818E 03	-0.239010E 02	0
300	0.384000E 03	-0.174907E 03	0.0	110
701	0.400232E 03	-0.167376E 03	-0.254400E 02	0
400	0.416316E 03	-0.159549E 03	0.0	0
402	0.416456E 03	-0.159828E 03	0.0	0
403	0.435753E 03	-0.148633E 03	0.0	0
404	0.452077E 03	-0.136341E 03	0.0	0
405	0.466891E 03	-0.122265E 03	0.0	0
406	0.480000E 03	-0.106591E 03	0.0	0
407	0.488620E 03	-0.938918E 02	0.0	0
408	0.496117E 03	-0.805000E 02	0.0	0
409	0.501488E 03	-0.688347E 02	0.0	0
410	0.506007E 03	-0.568137E 02	0.0	0
411	0.509650E 03	-0.444996E 02	0.0	0
412	0.512771E 03	-0.298413E 02	0.0	0
413	0.514653E 03	-0.149730E 02	0.0	0
414	0.515281E 03	0.0	0.0	0
301	0.480000E 03	-0.329500E 03	0.0	110
500	0.515281E 03	0.436875E 02	0.0	0
501	0.499500E 03	0.436875E 02	0.0	0
503	0.515281E 03	0.117406E 03	0.0	0
600	0.515219E 03	0.117406E 03	0.0	0
601	0.515219E 03	0.200250E 03	0.0	0

II.6.2.7

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

NODE NO.	ELASTIC FOUNDATION CONSTANTS R-DIR.	Z-DIR.	ROTATION
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	0.0
104	0.0	0.0	0.0
200	0.0	0.0	0.0
105	0.0	0.0	0.0
201	0.0	0.0	0.0
203	0.0	0.0	0.0
202	0.0	0.0	0.0
106	0.0	0.0	0.0
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	0.0
110	0.0	0.0	0.0
111	0.0	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	0.0
300	0.0	0.0	0.0
701	0.0	0.0	0.0
400	0.0	0.0	0.0
402	0.0	0.0	0.0
403	0.0	0.0	0.0
404	0.0	0.0	0.0
405	0.0	0.0	0.0
406	0.0	0.0	0.0
407	0.0	0.0	0.0
408	0.0	0.0	0.0
409	0.0	0.0	0.0
410	0.0	0.0	0.0
411	0.0	0.0	0.0
412	0.0	0.0	0.0
413	0.0	0.0	0.0
414	0.0	0.0	0.0
301	0.0	0.0	0.0
500	0.0	0.0	0.0
501	0.0	0.0	0.0
503	0.0	0.0	0.0
600	0.0	0.0	0.0
601	0.0	0.0	0.0

HANFORD NO. 2 CONTAINMENT VESSEL

II-6.28

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

NODE NO.	PRESCRIBED DISPLACEMENTS R-DIR.	Z-DIR.	ROTATION
101	0.0	-0.550000E-01	0.0
102	0.0	-0.550000E-01	0.0
103	0.0	-0.550000E-01	0.0
104	0.0	-0.550000E-01	0.0
200	0.0	-0.550000E-01	0.0
105	0.0	0.0	0.0
201	0.0	0.0	0.0
203	0.0	0.0	0.0
202	0.0	-0.550000E-01	0.0
106	0.0	-0.550000E-01	0.0
107	0.0	-0.550000E-01	0.0
108	0.0	-0.550000E-01	0.0
109	0.0	-0.550000E-01	0.0
110	0.0	-0.550000E-01	0.0
111	0.0	-0.550000E-01	0.0
112	0.0	-0.550000E-01	0.0
113	0.0	-0.550000E-01	0.0
300	0.0	0.0	0.0
701	0.0	-0.550000E-01	0.0
400	0.0	0.0	0.0
402	0.0	0.0	0.0
403	0.0	0.0	0.0
404	0.0	0.0	0.0
405	0.0	0.0	0.0
406	0.0	0.0	0.0
407	0.0	0.0	0.0
408	0.0	0.0	0.0
409	0.0	0.0	0.0
410	0.0	0.0	0.0
411	0.0	0.0	0.0
412	0.0	0.0	0.0
413	0.0	0.0	0.0
414	0.0	0.0	0.0
301	0.0	0.0	0.0
500	0.0	0.0	0.0
501	0.0	0.0	0.0
503	0.0	0.0	0.0
600	0.0	0.0	0.0
601	0.0	0.0	0.0

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 101 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 102 AND 101

THICKNESS = 0.812500E 00 RADIUS = 0.931671E 03

ANGLE PHI-A = 0.175402E 03 ANGLE PHI-B = 0.177000E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 102 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 103 AND 102

THICKNESS = 0.812500E 00 RADIUS = 0.931567E 03

ANGLE PHI-A = 0.173804E 03 ANGLE PHI-B = 0.175402E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 103 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 104 AND 103

THICKNESS = 0.812500E 00 RADIUS = 0.931852E 03

ANGLE PHI-A = 0.172209E 03 ANGLE PHI-B = 0.173806E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 104 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 200 AND 104

THICKNESS = 0.812500E 00 RADIUS = 0.931790E 03

ANGLE PHI-A = 0.171410E 03 ANGLE PHI-B = 0.172209E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

II-6.2.10

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

```
BODY NO.  202 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
    EDGE NODES ARE  105 AND  200
    THICKNESS =  0.812500E 00  RADIUS =  0.931697E 03
    ANGLE PHI-A =  0.170611E 03  ANGLE PHI-B =  0.171409E 03
    E =  0.279000E 08  NU =  0.300000E 00  ALPHA =  0.650000E-05

BODY NO.  105 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
    EDGE NODES ARE  107 AND  106
    THICKNESS =  0.812500E 00  RADIUS =  0.931775E 03
    ANGLE PHI-A =  0.166840E 03  ANGLE PHI-B =  0.168726E 03
    E =  0.279000E 08  NU =  0.300000E 00  ALPHA =  0.650000E-05

BODY NO.  106 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
    EDGE NODES ARE  108 AND  107
    THICKNESS =  0.812500E 00  RADIUS =  0.931719E 03
    ANGLE PHI-A =  0.164954E 03  ANGLE PHI-B =  0.166839E 03
    E =  0.279000E 08  NU =  0.300000E 00  ALPHA =  0.650000E-05

BODY NO.  107 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
    EDGE NODES ARE  109 AND  108
    THICKNESS =  0.812500E 00  RADIUS =  0.931646E 03
    ANGLE PHI-A =  0.163067E 03  ANGLE PHI-B =  0.164953E 03
    E =  0.279000E 08  NU =  0.300000E 00  ALPHA =  0.650000E-05
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II-6.2.11

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 108 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 110 AND 109

THICKNESS = 0.812500E 00 RADIUS = 0.931760E 03

ANGLE PHI-A = 0.161184E 03 ANGLE PHI-B = 0.163069E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 109 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 111 AND 110

THICKNESS = 0.812500E 00 RADIUS = 0.931688E 03

ANGLE PHI-A = 0.159297E 03 ANGLE PHI-B = 0.161182E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 110 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 112 AND 111

THICKNESS = 0.812500E 00 RADIUS = 0.931740E 03

ANGLE PHI-A = 0.157412E 03 ANGLE PHI-B = 0.159298E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 111 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 113 AND 112

THICKNESS = 0.812500E 00 RADIUS = 0.931740E 03

ANGLE PHI-A = 0.156099E 03 ANGLE PHI-B = 0.157412E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 112 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 300 AND 113

THICKNESS = 0.812500E 00 RADIUS = 0.931727E 03

ANGLE PHI-A = 0.155661E 03 ANGLE PHI-B = 0.156099E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 204 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 202 AND 105

THICKNESS = 0.812500E 00 RADIUS = 0.931723E 03

ANGLE PHI-A = 0.169668E 03 ANGLE PHI-B = 0.170611E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 200 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 106 AND 202

THICKNESS = 0.812500E 00 RADIUS = 0.931728E 03

ANGLE PHI-A = 0.168725E 03 ANGLE PHI-B = 0.169668E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 201 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 105 AND 201 THICKNESS = 0.937500E 00

RADIUS = 0.152000E 03 LENGTH = 0.842640E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 203 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 203 AND 105 THICKNESS = 0.937500E 00

RADIUS = 0.152000E 03 LENGTH = 0.359746E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 302 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 701 AND 300

THICKNESS = 0.812500E 00 RADIUS = 0.931715E 03

ANGLE PHI-A = 0.154560E 03 ANGLE PHI-B = 0.155661E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 300 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 400 AND 701

THICKNESS = 0.812500E 00 RADIUS = 0.931715E 03

ANGLE PHI-A = 0.153460E 03 ANGLE PHI-B = 0.154560E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 301 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 406 AND 301 THICKNESS = 0.687500E 00

RADIUS = 0.480000E 03 LENGTH = 0.222909E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 401 -- BODY TYPE 9, RIGID CONNECTOR

EDGE NODES ARE 402 AND 400

BODY NO. 402 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 403 AND 402

THICKNESS = 0.143750E 01 RADIUS = 0.849196E 03

ANGLE PHI-A = 0.149127E 03 ANGLE PHI-B = 0.150632E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 403 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 404 AND 403

THICKNESS = 0.143750E 01 RADIUS = 0.738042E 03

ANGLE PHI-A = 0.142227E 03 ANGLE PHI-B = 0.143813E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 404 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 405 AND 404

THICKNESS = 0.143750E 01 RADIUS = 0.667137E 03

ANGLE PHI-A = 0.135586E 03 ANGLE PHI-B = 0.137341E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 405 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 406 AND 405

THICKNESS = 0.143750E 01 RADIUS = 0.617292E 03

ANGLE PHI-A = 0.128960E 03 ANGLE PHI-B = 0.130856E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 406 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 407 AND 406

THICKNESS = 0.143750E 01 RADIUS = 0.585391E 03

ANGLE PHI-A = 0.123417E 03 ANGLE PHI-B = 0.124919E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 407 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 408 AND 407

THICKNESS = 0.143750E 01 RADIUS = 0.564326E 03

ANGLE PHI-A = 0.118462E 03 ANGLE PHI-B = 0.120020E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 408 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 409 AND 408

THICKNESS = 0.143750E 01 RADIUS = 0.549169E 03

ANGLE PHI-A = 0.114052E 03 ANGLE PHI-B = 0.115392E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 409 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
EDGE NODES ARE 410 AND 409
THICKNESS = 0.143750E 01 RADIUS = 0.538205E 03
ANGLE PHI-A = 0.109919E 03 ANGLE PHI-B = 0.111286E 03
E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 410 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
EDGE NODES ARE 411 AND 410
THICKNESS = 0.143750E 01 RADIUS = 0.529625E 03
ANGLE PHI-A = 0.105786E 03 ANGLE PHI-B = 0.107175E 03
E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 411 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
EDGE NODES ARE 412 AND 411
THICKNESS = 0.143750E 01 RADIUS = 0.522724E 03
ANGLE PHI-A = 0.101199E 03 ANGLE PHI-B = 0.102842E 03
E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 412 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE
EDGE NODES ARE 413 AND 412
THICKNESS = 0.143750E 01 RADIUS = 0.517865E 03
ANGLE PHI-A = 0.963845E 02 ANGLE PHI-B = 0.980427E 02
E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

II.6.2.17

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 413 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 414 AND 413

THICKNESS = 0.143750E 01 RADIUS = 0.515474E 03

ANGLE PHI-A = 0.915686E 02 ANGLE PHI-B = 0.932344E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 414 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 500 AND 414 THICKNESS = 0.143750E 01

RADIUS = 0.515281E 03 LENGTH = 0.436875E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 500 --BODY TYPE 3, FLAT ANNULUS

EDGE NODES ARE 501 AND 500 THICKNESS = 0.375000E 00

INSIDE RADIUS =0.499500E 03 OUTSIDE RADIUS = 0.515281E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 502 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 503 AND 500 THICKNESS = 0.143750E 01

RADIUS = 0.515281E 03 LENGTH = 0.737188E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

BODY NO. 503 -- BODY TYPE 9, RIGID CONNECTOR

EDGE NODES ARE 600 AND 503

BODY NO. 600 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 601 AND 600 THICKNESS = 0.131250E 01

RADIUS = 0.515219E 03 LENGTH = 0.828438E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.19

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 101  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.647900E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 102  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.647200E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 103  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.646100E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 104  BODY TYPE   4  X = MERIDIAN ANGLE
    PN = ( 0.644700E 02) + ( 0.0          )*COS(X)
      + ( 0.0          )*COS(X)*COS(X)
    PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
    T = ( 0.0          + ( 0.0          )*Z/H)
     + ( 0.0          + ( 0.0          )*Z/H)*X
     + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 202  BODY TYPE   4  X = MERIDIAN ANGLE
    PN = ( 0.643900E 02) + ( 0.0          )*COS(X)
      + ( 0.0          )*COS(X)*COS(X)
    PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
    T = ( 0.0          + ( 0.0          )*Z/H)
     + ( 0.0          + ( 0.0          )*Z/H)*X
     + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 105  BODY TYPE   4  X = MERIDIAN ANGLE
    PN = ( 0.640700E 02) + ( 0.0          )*COS(X)
      + ( 0.0          )*COS(X)*COS(X)
    PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
    T = ( 0.0          + ( 0.0          )*Z/H)
     + ( 0.0          + ( 0.0          )*Z/H)*X
     + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

II.6.221

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 106  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.637800E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 107  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.634600E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 108  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.631000E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

II.6.2.22

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 109  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.626900E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 110  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.622400E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 111  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.617500E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 112  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.613800E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 204  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.643000E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 200  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.641900E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

II.6224

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 201   BODY TYPE    1   X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.0          ) +  ( 0.0          )*X
     PPHI = ( 0.0          ) + ( 0.0          )*X
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 203   BODY TYPE    1   X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.0          ) +  ( 0.0          )*X
     PPHI = ( 0.0          ) + ( 0.0          )*X
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 302   BODY TYPE    4   X = MERIDIAN ANGLE
     PN = ( 0.612600E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 300  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.609300E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 301  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.0          ) + ( 0.0          )*X
     PPHI = ( 0.0          ) + ( 0.0          )*X
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 402  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.606000E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

II.6.2.26

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 403  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.601200E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 404  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.595700E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 405  BODY TYPE   4   X = MERIDIAN ANGLE
     PN = ( 0.589800E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 406  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.583000E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 407  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.577500E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 408  BODY TYPE   4  X = MERIDIAN ANGLE
     PN = ( 0.571700E 02) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

HANFORD NO. 2 CONTAINMENT VESSEL II-6228

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 409  BODY TYPE   4  X = MERIDIAN ANGLE
    PN = ( 0.566600E 02) + ( 0.0          )*COS(X)
      + ( 0.0          )*COS(X)*COS(X)
    PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
    T = ( 0.0          + ( 0.0          )*Z/H)
     + ( 0.0          + ( 0.0          )*Z/H)*X
     + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 410  BODY TYPE   4  X = MERIDIAN ANGLE
    PN = ( 0.561400E 02) + ( 0.0          )*COS(X)
      + ( 0.0          )*COS(X)*COS(X)
    PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
    T = ( 0.0          + ( 0.0          )*Z/H)
     + ( 0.0          + ( 0.0          )*Z/H)*X
     + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 411  BODY TYPE   4  X = MERIDIAN ANGLE
    PN = ( 0.556100E 02) + ( 0.0          )*COS(X)
      + ( 0.0          )*COS(X)*COS(X)
    PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
    T = ( 0.0          + ( 0.0          )*Z/H)
     + ( 0.0          + ( 0.0          )*Z/H)*X
     + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

```
  HANFORD NO. 2 CONTAINMENT VESSEL

  ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

  VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

  BODY LOADS

BODY NO. 412  BODY TYPE   4  X = MERIDIAN ANGLE

     PN = ( 0.549700E 02) + ( 0.0          )*COS(X)

       + ( 0.0          )*COS(X)*COS(X)

     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)

     T = ( 0.0          + ( 0.0          )*Z/H)

      + ( 0.0          + ( 0.0          )*Z/H)*X

      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 413  BODY TYPE   4  X = MERIDIAN ANGLE

     PN = ( 0.543300E 02) + ( 0.0          )*COS(X)

       + ( 0.0          )*COS(X)*COS(X)

     PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)

     T = ( 0.0          + ( 0.0          )*Z/H)

      + ( 0.0          + ( 0.0          )*Z/H)*X

      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 414  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE

     PN = ( 0.517820E 02) +  ( 0.433000E-01)*X

     PPHI = ( 0.0          ) + ( 0.0          )*X

     T = ( 0.0          + ( 0.0          )*Z/H)

      + ( 0.0          + ( 0.0          )*Z/H)*X

      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

II.C.2.30

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 500   BODY TYPE    3   X = RADIUS
     PN = ( 0.0            ) +  ( 0.0            )*X
     PPHI = ( 0.0            ) + ( 0.0            )*X
     T = ( 0.0              + ( 0.0            )*Z/H)
      + ( 0.0              + ( 0.0            )*Z/H)*X
      + ( 0.0              + ( 0.0            )*Z/H)*X*X
BODY NO. 502   BODY TYPE    1   X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.485900E 02) +  ( 0.433000E-01)*X
     PPHI = ( 0.0            ) + ( 0.0            )*X
     T = ( 0.0              + ( 0.0            )*Z/H)
      + ( 0.0              + ( 0.0            )*Z/H)*X
      + ( 0.0              + ( 0.0            )*Z/H)*X*X
BODY NO. 600   BODY TYPE    1   X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.450000E 02) +  ( 0.433000E-01)*X
     PPHI = ( 0.0            ) + ( 0.0            )*X
     T = ( 0.0              + ( 0.0            )*Z/H)
      + ( 0.0              + ( 0.0            )*Z/H)*X
      + ( 0.0              + ( 0.0            )*Z/H)*X*X
```

II.6.231

HANFORD NO. 2 CONTAINMENT VESSEL

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER
CIRCUMFERENTIAL LINE LOADS

NODE	R-DIR.	Z-DIR.	MOMENT
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	0.0
104	0.0	0.0	0.0
200	0.0	0.0	0.0
105	0.0	0.0	0.0
201	0.0	0.0	0.0
203	0.0	0.0	0.0
202	0.0	0.0	0.0
106	0.0	0.0	0.0
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	0.0
110	0.0	0.0	0.0
111	0.0	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	0.0
300	0.0	0.0	0.0
701	0.0	0.0	0.0
400	0.0	0.0	0.0
402	0.0	0.0	0.0
403	0.0	0.0	0.0
404	0.0	0.0	0.0
405	0.0	0.0	0.0
406	0.0	0.0	0.0
407	0.0	0.0	0.0
408	0.0	0.0	0.0
409	0.0	0.0	0.0
410	0.0	0.0	0.0
411	0.0	0.0	0.0
412	0.0	0.0	0.0
413	0.0	0.0	0.0
414	0.0	0.0	0.0
301	0.0	0.0	0.0
500	0.0	0.0	0.0
501	0.0	0.0	0.0
503	0.0	0.0	0.0
600	0.0	0.0	0.0
601	0.0	0.115924E 05	0.0

$= \frac{PR}{2} = \frac{(45)(515.21875)}{2}$

II.6.2.32

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

NODE NO.	NODE DISPLACEMENTS R OR R' DIR.	Z OR Z' DIR.	ROTATION	OBLIQUE AXIS ANGLE
101	0.877801E-02	-0.550000E-01	0.167297E-01	-0.300000E 01
102	0.553874E-02	-0.550000E-01	-0.276795E-02	-0.459700E 01
103	0.511606E-02	-0.550000E-01	0.241058E-02	-0.619500E 01
104	0.422202E-02	-0.550000E-01	-0.262118E-02	-0.779200E 01
200	0.443483E-02	-0.550000E-01	-0.222700E-02	-0.859100E 01
105	0.593667E-02	-0.443679E-02	-0.672640E-04	0.0
201	0.0	0.0	0.255748E-03	0.0
203	-0.329964E-03	-0.453979E-02	0.186587E-06	0.0
202	0.578573E-02	-0.550000E-01	0.847850E-03	-0.103320E 02
106	0.604101E-02	-0.550000E-01	0.604371E-02	-0.112750E 02
107	0.387270E-02	-0.550000E-01	-0.800292E-03	-0.131610E 02
108	0.284649E-02	-0.550000E-01	0.636855E-03	-0.150470E 02
109	0.179554E-02	-0.550000E-01	0.282198E-03	-0.169310E 02
110	0.886850E-03	-0.550000E-01	0.119048E-03	-0.188170E 02
111	0.163698E-03	-0.550000E-01	0.827730E-03	-0.207030E 02
112	-0.881705E-03	-0.550000E-01	-0.225189E-02	-0.225880E 02
113	-0.616523E-03	-0.550000E-01	-0.884366E-02	-0.239010E 02
300	0.0	0.0	-0.385233E-02	0.0
701	0.844661E-02	-0.550000E-01	0.616582E-02	-0.254400E 02
400	0.429124E-01	-0.527621E-01	-0.989898E-02	0.0
402	0.456802E-01	-0.513797E-01	-0.989898E-02	0.0
403	-0.357568E-01	0.101335E 00	-0.463893E-02	0.0
404	-0.437908E-01	0.122338E 00	0.214475E-02	0.0
405	0.198227E-01	0.633104E-01	0.540704E-02	0.0
406	0.756469E-01	0.216836E-01	-0.130462E-02	0.0
407	0.121328E-01	0.692133E-01	-0.694181E-02	0.0
408	-0.707187E-01	0.120897E 00	-0.528331E-02	0.0
409	-0.115252E 00	0.146172E 00	-0.274341E-02	0.0
410	-0.134574E 00	0.158244E 00	-0.841126E-03	0.0
411	-0.133627E 00	0.162668E 00	0.813660E-03	0.0
412	-0.105088E 00	0.161830E 00	0.317951E-02	0.0
413	-0.303998E-01	0.157125E 00	0.692556E-02	0.0
414	0.957362E-01	0.155590E 00	0.905750E-02	0.0
301	0.0	0.0	-0.103428E-02	0.0
500	0.281594E 00	0.161300E 00	0.278407E-03	0.0
501	0.284109E 00	0.165713E 00	0.280922E-03	0.0
503	0.290752E 00	0.168463E 00	0.870172E-03	0.0
600	0.290752E 00	0.168517E 00	0.870172E-03	0.0
601	0.276648E 00	0.178387E 00	-0.369181E-03	0.0

II.6.233

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER.

NODE NO.	R OR R' DIR.	REACTION LOADS Z OR Z' DIR.	MOMENT	OBLIQUE AXIS ANGLE
101	0.0	0.641230E 03	0.0	-0.300000E 01
102	0.0	0.166278E 04	0.0	-0.459700E 01
103	0.0	0.151767E 04	0.0	-0.619500E 01
104	0.0	0.139498E 04	0.0	-0.779200E 01
200	0.0	0.182492E 03	0.0	-0.859100E 01
201	-0.124730E 02	0.136192E 04	0.0	0.0
202	0.0	0.425248E 03	0.0	-0.103320E 02
106	0.0	0.154408E 04	0.0	-0.112750E 02
107	0.0	0.178847E 04	0.0	-0.131610E 02
108	0.0	0.173068E 04	0.0	-0.150470E 02
109	0.0	0.173281E 04	0.0	-0.169310E 02
110	0.0	0.171228E 04	0.0	-0.188170E 02
111	0.0	0.172406E 04	0.0	-0.207030E 02
112	0.0	0.162734E 04	0.0	-0.225880E 02
113	0.0	0.120525E 03	0.0	-0.239010E 02
300	-0.922977E 04	-0.290825E 04	0.0	0.0
701	0.0	0.790895E 03	0.0	-0.254400E 02
301	0.859887E 01	-0.194703E 04	0.0	0.0

II.6.2.34

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 101

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	1846.	3568.	-3987.	-1150.	824.
2	1813.	3616.	-2950.	-779.	758.
3	1776.	3774.	-1992.	-446.	691.
4	1734.	4012.	-1115.	-152.	624.
5	1686.	4305.	-319.	104.	555.
6	1629.	4628.	393.	322.	486.
7	1564.	4959.	1019.	502.	416.
8	1489.	5281.	1557.	644.	345.
9	1404.	5575.	2006.	749.	273.
10	1310.	5829.	2362.	816.	200.
11	1206.	6031.	2623.	846.	125.
12	1094.	6173.	2785.	840.	50.
13	974.	6251.	2846.	798.	-28.
14	847.	6263.	2800.	721.	-108.
15	715.	6212.	2644.	609.	-190.
16	578.	6105.	2372.	464.	-274.
17	438.	5953.	1979.	285.	-361.
18	295.	5771.	1457.	76.	-451.
19	149.	5582.	800.	-162.	-544.
20	0.	5413.	-0.	-427.	-641.

II-62.35

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 101

STATION	DISPLACEMENTS		
	NORMAL	TANGENTIAL	ROTATION
1	0.5500E-01	-0.5538E-02	-0.2768E-02
2	0.5567E-01	-0.5573E-02	-0.6246E-02
3	0.6070E-01	-0.5616E-02	-0.8748E-02
4	0.6882E-01	-0.5675E-02	-0.1034E-01
5	0.7889E-01	-0.5756E-02	-0.1112E-01
6	0.8987E-01	-0.5860E-02	-0.1114E-01
7	0.1008E 00	-0.5991E-02	-0.1049E-01
8	0.1110E 00	-0.6147E-02	-0.9263E-02
9	0.1196E 00	-0.6327E-02	-0.7532E-02
10	0.1262E 00	-0.6529E-02	-0.5389E-02
11	0.1302E 00	-0.6749E-02	-0.2922E-02
12	0.1315E 00	-0.6983E-02	-0.2283E-03
13	0.1297E 00	-0.7225E-02	0.2598E-02
14	0.1250E 00	-0.7470E-02	0.5452E-02
15	0.1175E 00	-0.7714E-02	0.8226E-02
16	0.1074E 00	-0.7952E-02	0.1081E-01
17	0.9534E-01	-0.8179E-02	0.1308E-01
18	0.8195E-01	-0.8393E-02	0.1492E-01
19	0.6813E-01	-0.8593E-02	0.1618E-01
20	0.5500E-01	-0.8778E-02	0.1673E-01

II-62-36

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 101

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	2272.	4391.	-33964.	-6061.	38509.	14843.
2	2231.	4450.	-24584.	-2631.	29046.	11532.
3	2186.	4644.	-15918.	587.	20290.	8702.
4	2135.	4938.	-7995.	3555.	12265.	6320.
5	2075.	5298.	-823.	6244.	4973.	4352.
6	2005.	5696.	5577.	8623.	-1566.	2769.
7	1925.	6104.	11183.	10665.	-7334.	1542.
8	1832.	6500.	15984.	12353.	-12320.	646.
9	1728.	6862.	19956.	13666.	-16500.	58.
10	1612.	7174.	23075.	14590.	-19851.	-241.
11	1484.	7423.	25320.	15115.	-22351.	-269.
12	1346.	7598.	26659.	15235.	-23967.	-39.
13	1199.	7693.	27063.	14949.	-24666.	438.
14	1043.	7708.	26495.	14261.	-24409.	1156.
15	880.	7646.	24914.	13182.	-23154.	2110.
16	712.	7514.	22274.	11727.	-20850.	3301.
17	539.	7327.	18523.	9921.	-17445.	4732.
18	363.	7103.	13608.	7799.	-12882.	6408.
19	183.	6871.	7457.	5399.	-7090.	8342.
20	0.	6662.	0.	2779.	0.	10545.

II.6.2.37

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 101 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	5154.		33964.	* *	38509.	* *
2	5125.		24584.	*	29046.	* *
3	5232.		16505.		20290.	*
4	5440.		11550.		12265.	
5	5719.		7067.		4973.	
6	6038.		8623.		4335.	
7	6373.		11183.		8876.	
8	6699.		15984.		12966.	
9	6998.		19956.	*	16559.	
10	7255.		23075.	*	19851.	*
11	7458.		25320.	*	22351.	*
12	7604.		26659.	*	23967.	*
13	7696.		27063.	*	25104.	*
14	7745.		26495.	*	25565.	*
15	7768.		24914.	*	25264.	*
16	7777.		22274.	*	24152.	*
17	7776.		18523.		22178.	*
18	7774.		13608.		19291.	
19	7788.		7457.		15432.	
20	7846.		2779.		10545.	

* > Sm

** > 1.5 Sm

*** > 3 Sm

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 102

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2249.	3160.	-3254.	-1006.	709.
2	2237.	3077.	-2361.	-703.	637.
3	2224.	3078.	-1557.	-438.	565.
4	2211.	3137.	-847.	-209.	492.
5	2196.	3233.	-230.	-16.	418.
6	2180.	3346.	289.	141.	343.
7	2162.	3459.	711.	261.	267.
8	2141.	3559.	1033.	347.	190.
9	2119.	3635.	1251.	397.	112.
10	2095.	3681.	1365.	413.	33.
11	2070.	3692.	1371.	395.	-47.
12	2044.	3670.	1266.	344.	-128.
13	2019.	3616.	1048.	261.	-211.
14	1993.	3539.	712.	146.	-296.
15	1969.	3451.	255.	-1.	-382.
16	1945.	3367.	-326.	-176.	-469.
17	1922.	3308.	-1037.	-381.	-559.
18	1898.	3301.	-1881.	-612.	-650.
19	1874.	3375.	-2862.	-869.	-743.
20	1846.	3568.	-3987.	-1150.	-838.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.39

BODY NO. 102

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5501E-01	-0.5115E-02	0.2411E-02
2	0.5113E-01	-0.5114E-02	-0.3771E-03
3	0.5069E-01	-0.5109E-02	-0.2330E-02
4	0.5262E-01	-0.5107E-02	-0.3534E-02
5	0.5598E-01	-0.5111E-02	-0.4080E-02
6	0.5996E-01	-0.5124E-02	-0.4060E-02
7	0.6387E-01	-0.5145E-02	-0.3570E-02
8	0.6714E-01	-0.5175E-02	-0.2706E-02
9	0.6937E-01	-0.5212E-02	-0.1567E-02
10	0.7027E-01	-0.5254E-02	-0.2574E-03
11	0.6971E-01	-0.5298E-02	0.1118E-02
12	0.6770E-01	-0.5341E-02	0.2451E-02
13	0.6442E-01	-0.5382E-02	0.3630E-02
14	0.6019E-01	-0.5417E-02	0.4537E-02
15	0.5552E-01	-0.5446E-02	0.5054E-02
16	0.5105E-01	-0.5468E-02	0.5055E-02
17	0.4764E-01	-0.5484E-02	0.4411E-02
18	0.4632E-01	-0.5497E-02	0.2986E-02
19	0.4830E-01	-0.5512E-02	0.6421E-03
20	0.5501E-01	-0.5538E-02	-0.2768E-02

II.6.2.40

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 102

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	2769.	3889.	-26805.	-5253.	32342.	13031.
2	2753.	3787.	-18702.	-2606.	24208.	10181.
3	2737.	3788.	-11418.	-190.	16893.	7766.
4	2721.	3861.	-4975.	1966.	10417.	5757.
5	2703.	3979.	609.	3835.	4797.	4124.
6	2683.	4118.	5313.	5395.	53.	2840.
7	2660.	4257.	9124.	6632.	-3803.	1882.
8	2635.	4380.	12020.	7531.	-6750.	1229.
9	2608.	4474.	13981.	8083.	-8766.	865.
10	2578.	4530.	14985.	8285.	-9828.	776.
11	2548.	4545.	15008.	8138.	-9913.	952.
12	2516.	4516.	14025.	7646.	-8992.	1387.
13	2485.	4450.	12006.	6820.	-7037.	2080.
14	2453.	4356.	8923.	5678.	-4016.	3033.
15	2423.	4247.	4742.	4242.	105.	4252.
16	2394.	4144.	-570.	2542.	5358.	5745.
17	2365.	4072.	-7056.	613.	11787.	7531.
18	2336.	4062.	-14755.	-1501.	19428.	9626.
19	2306.	4154.	-23710.	-3746.	28322.	12054.
20	2272.	4391.	-33965.	-6061.	38509.	14843.

II.6.241

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 102   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	4410.		26805.	*	32342.	* *
2	4222.		18702.		24208.	*
3	4140.		11418.		16893.	
4	4136.		6940.		10417.	
5	4184.		3835.		4797.	
6	4259.		5395.		2840.	
7	4345.		9124.		5685.	
8	4426.		12020.		7979.	
9	4490.		13981.		9631.	
10	4532.		14985.		10604.	
11	4548.		15008.		10864.	
12	4539.		14025.		10380.	
13	4510.		12006.		9118.	
14	4472.		8923.		7049.	
15	4437.		4742.		4252.	
16	4424.		3112.		5745.	
17	4459.		7669.		11787.	
18	4569.		14755.		19428.	*
19	4793.		23710.	*	28322.	*
20	5175.		33965.	* *	38509.	* *

II.62.42

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 103

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2551.	2854.	-2762.	-803.	710.
2	2547.	2947.	-1859.	-509.	637.
3	2540.	3106.	-1050.	-251.	563.
4	2532.	3308.	-337.	-29.	489.
5	2522.	3528.	280.	157.	414.
6	2508.	3747.	799.	308.	339.
7	2493.	3947.	1219.	425.	264.
8	2474.	4115.	1539.	507.	187.
9	2454.	4240.	1756.	555.	111.
10	2432.	4313.	1870.	570.	33.
11	2410.	4332.	1877.	551.	-45.
12	2386.	4295.	1776.	501.	-125.
13	2364.	4206.	1565.	418.	-206.
14	2342.	4069.	1240.	303.	-287.
15	2321.	3897.	800.	158.	-371.
16	2303.	3704.	241.	-17.	-455.
17	2287.	3508.	-441.	-222.	-541.
18	2273.	3333.	-1248.	-456.	-629.
19	2261.	3206.	-2185.	-717.	-718.
20	2249.	3160.	-3254.	-1006.	-809.

II.6.2A3

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 103

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5501E-01	-0.4224E-02	-0.2621E-02
2	0.5865E-01	-0.4205E-02	-0.4930E-02
3	0.6501E-01	-0.4197E-02	-0.6392E-02
4	0.7299E-01	-0.4203E-02	-0.7098E-02
5	0.8163E-01	-0.4226E-02	-0.7143E-02
6	0.9010E-01	-0.4266E-02	-0.6619E-02
7	0.9770E-01	-0.4323E-02	-0.5625E-02
8	0.1039E 00	-0.4394E-02	-0.4258E-02
9	0.1082E 00	-0.4477E-02	-0.2618E-02
10	0.1103E 00	-0.4568E-02	-0.8069E-03
11	0.1101E 00	-0.4662E-02	0.1072E-02
12	0.1077E 00	-0.4756E-02	0.2911E-02
13	0.1030E 00	-0.4844E-02	0.4600E-02
14	0.9649E-01	-0.4924E-02	0.6029E-02
15	0.8855E-01	-0.4991E-02	0.7082E-02
16	0.7980E-01	-0.5044E-02	0.7639E-02
17	0.7103E-01	-0.5081E-02	0.7579E-02
18	0.6319E-01	-0.5104E-02	0.6775E-02
19	0.5742E-01	-0.5115E-02	0.5098E-02
20	0.5501E-01	-0.5118E-02	0.2411E-02

II.6.2.44

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 103

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3140.	3513.	-21961.	-3784.	28241.	10810.
2	3134.	3627.	-13763.	-999.	20031.	8253.
3	3127.	3823.	-6421.	1540.	12674.	6107.
4	3117.	4071.	53.	3804.	6180.	4338.
5	3104.	4342.	5651.	5770.	556.	2914.
6	3087.	4611.	10353.	7413.	-4179.	1809.
7	3068.	4858.	14152.	8718.	-8016.	997.
8	3045.	5065.	17035.	9671.	-10944.	458.
9	3020.	5218.	18984.	10262.	-12943.	174.
10	2994.	5309.	19987.	10487.	-14000.	131.
11	2966.	5332.	20026.	10343.	-14095.	321.
12	2937.	5287.	19082.	9836.	-13208.	737.
13	2909.	5176.	17134.	8973.	-11315.	1379.
14	2882.	5009.	14156.	7766.	-8392.	2251.
15	2857.	4797.	10128.	6235.	-4414.	3358.
16	2835.	4559.	5022.	4403.	647.	4714.
17	2815.	4317.	-1196.	2298.	6826.	6337.
18	2797.	4102.	-8549.	-41.	14144.	8245.
19	2782.	3946.	-17072.	-2574.	22637.	10466.
20	2769.	3889.	-26805.	-5253.	32342.	13032.

II.6.2.45

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 103   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	4090.		21961.	*	28241.	*
2	4018.		13763.		20031.	*
3	4137.		7961.		12674.	
4	4314.		3804.		6180.	
5	4520.		5770.		2914.	
6	4733.		10353.		5988.	
7	4933.		14152.		9013.	
8	5103.		17035.		11402.	
9	5232.		18984.		13117.	
10	5310.		19987.	*	14131.	
11	5334.		20026.	*	14416.	
12	5305.		19082.		13945.	
13	5225.		17134.		12695.	
14	5103.		14156.		10643.	
15	4952.		10128.		7772.	
16	4789.		5022.		4714.	
17	4636.		3495.		6826.	
18	4521.		8549.		14144.	
19	4476.		17072.		22637.	*
20	4541.		26805.	*	32342.	* *

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.46

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 104

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2574.	2824.	925.	297.	105.
2	2573.	2857.	986.	311.	65.
3	2572.	2882.	1021.	317.	25.
4	2570.	2900.	1028.	315.	-15.
5	2568.	2911.	1007.	304.	-55.
6	2567.	2914.	959.	285.	-96.
7	2565.	2911.	883.	258.	-136.
8	2563.	2901.	779.	223.	-177.
9	2562.	2886.	647.	180.	-218.
10	2560.	2866.	486.	129.	-259.
11	2559.	2843.	296.	70.	-301.
12	2558.	2819.	76.	3.	-343.
13	2557.	2796.	-172.	-71.	-385.
14	2556.	2775.	-450.	-153.	-427.
15	2555.	2759.	-759.	-243.	-469.
16	2555.	2750.	-1097.	-340.	-512.
17	2554.	2752.	-1467.	-445.	-555.
18	2553.	2768.	-1867.	-557.	-598.
19	2553.	2800.	-2298.	-676.	-642.
20	2552.	2854.	-2762.	-803.	-685.

II.6.2.47

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 104

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5496E-01	-0.4438E-02	-0.2227E-02
2	0.5624E-01	-0.4427E-02	-0.1752E-02
3	0.5722E-01	-0.4417E-02	-0.1253E-02
4	0.5789E-01	-0.4408E-02	-0.7427E-03
5	0.5826E-01	-0.4399E-02	-0.2349E-03
6	0.5832E-01	-0.4391E-02	0.2565E-03
7	0.5810E-01	-0.4383E-02	0.7177E-03
8	0.5763E-01	-0.4374E-02	0.1135E-02
9	0.5693E-01	-0.4365E-02	0.1494E-02
10	0.5606E-01	-0.4356E-02	0.1780E-02
11	0.5506E-01	-0.4345E-02	0.1979E-02
12	0.5401E-01	-0.4333E-02	0.2076E-02
13	0.5298E-01	-0.4321E-02	0.2057E-02
14	0.5207E-01	-0.4308E-02	0.1906E-02
15	0.5135E-01	-0.4293E-02	0.1608E-02
16	0.5095E-01	-0.4279E-02	0.1149E-02
17	0.5098E-01	-0.4264E-02	0.5122E-03
18	0.5156E-01	-0.4249E-02	-0.3174E-03
19	0.5284E-01	-0.4236E-02	-0.1356E-02
20	0.5496E-01	-0.4224E-02	-0.2621E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.C.2.48

BODY NO. 104

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3169.	3476.	11576.	6178.	-5239.	774.
2	3167.	3516.	12131.	6347.	-5797.	685.
3	3165.	3547.	12440.	6432.	-6110.	663.
4	3163.	3569.	12502.	6432.	-6176.	707.
5	3161.	3582.	12315.	6348.	-5993.	817.
6	3159.	3586.	11877.	6181.	-5559.	992.
7	3157.	3582.	11185.	5931.	-4871.	1233.
8	3155.	3570.	10237.	5600.	-3927.	1540.
9	3153.	3551.	9032.	5190.	-2726.	1913.
10	3151.	3527.	7567.	4702.	-1264.	2353.
11	3150.	3500.	5837.	4138.	463.	2861.
12	3148.	3470.	3844.	3502.	2453.	3438.
13	3147.	3441.	1583.	2796.	4711.	4086.
14	3146.	3415.	-948.	2023.	7240.	4808.
15	3145.	3396.	-3751.	1188.	10041.	5604.
16	3144.	3385.	-6830.	293.	13118.	6477.
17	3143.	3387.	-10187.	-657.	16474.	7431.
18	3143.	3406.	-13825.	-1656.	20110.	8469.
19	3142.	3446.	-17746.	-2700.	24030.	9593.
20	3140.	3512.	-21960.	-3785.	28241.	10809.

II.6.249

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 104   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	3488.		11576.		6013.	
2	3520.		12131.		6482.	
3	3548.		12440.		6773.	
4	3569.		12502.		6883.	
5	3586.		12315.		6810.	
6	3596.		11877.		6551.	
7	3602.		11185.		6104.	
8	3604.		10237.		5467.	
9	3602.		9032.		4639.	
10	3598.		7567.		3617.	
11	3595.		5837.		2861.	
12	3592.		3844.		3438.	
13	3594.		2796.		4711.	
14	3602.		2971.		7240.	
15	3618.		4939.		10041.	
16	3669.		7123.		13118.	
17	3752.		10187.		16474.	
18	3841.		13825.		20110.	*
19	3935.		17746.		24030.	*
20	4033.		21960.	*	28241.	*

II.62.50

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 202

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2546.	1649.	-2927.	-878.	666.
2	2549.	1644.	-2494.	-737.	628.
3	2553.	1662.	-2085.	-605.	590.
4	2556.	1697.	-1701.	-482.	551.
5	2560.	1747.	-1342.	-367.	513.
6	2563.	1809.	-1009.	-262.	474.
7	2566.	1881.	-700.	-166.	436.
8	2568.	1960.	-418.	-79.	397.
9	2571.	2044.	-161.	-0.	358.
10	2573.	2130.	70.	70.	319.
11	2574.	2217.	275.	131.	280.
12	2576.	2303.	454.	183.	241.
13	2576.	2386.	607.	227.	201.
14	2577.	2466.	733.	262.	162.
15	2577.	2541.	833.	289.	122.
16	2577.	2611.	905.	307.	83.
17	2577.	2674.	951.	317.	43.
18	2576.	2731.	970.	319.	3.
19	2575.	2781.	961.	312.	-38.
20	2574.	2824.	925.	297.	-78.

II.6.2.51

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 202

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5327E-02	-0.5134E-02	-0.6753E-04
2	0.5322E-02	-0.5076E-02	-0.1417E-02
3	0.6194E-02	-0.5019E-02	-0.2560E-02
4	0.7805E-02	-0.4962E-02	-0.3507E-02
5	0.1003E-01	-0.4907E-02	-0.4270E-02
6	0.1274E-01	-0.4854E-02	-0.4861E-02
7	0.1583E-01	-0.4804E-02	-0.5293E-02
8	0.1919E-01	-0.4757E-02	-0.5578E-02
9	0.2273E-01	-0.4712E-02	-0.5729E-02
10	0.2636E-01	-0.4672E-02	-0.5759E-02
11	0.3001E-01	-0.4635E-02	-0.5680E-02
12	0.3360E-01	-0.4601E-02	-0.5505E-02
13	0.3708E-01	-0.4570E-02	-0.5247E-02
14	0.4038E-01	-0.4543E-02	-0.4919E-02
15	0.4348E-01	-0.4519E-02	-0.4535E-02
16	0.4634E-01	-0.4497E-02	-0.4106E-02
17	0.4892E-01	-0.4478E-02	-0.3648E-02
18	0.5123E-01	-0.4462E-02	-0.3173E-02
19	0.5325E-01	-0.4448E-02	-0.2694E-02
20	0.5498E-01	-0.4435E-02	-0.2226E-02

II.62.52

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 202

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3133.	2029.	-23469.	-5947.	29735.	10005.
2	3137.	2024.	-19528.	-4671.	25803.	8719.
3	3142.	2045.	-15808.	-3450.	22091.	7540.
4	3146.	2088.	-12314.	-2288.	18606.	6465.
5	3150.	2150.	-9049.	-1189.	15349.	5490.
6	3154.	2227.	-6013.	-157.	12321.	4611.
7	3158.	2315.	-3208.	806.	9524.	3825.
8	3161.	2412.	-639.	1696.	6961.	3129.
9	3164.	2515.	1699.	2513.	4629.	2517.
10	3166.	2621.	3802.	3254.	2530.	1989.
11	3168.	2728.	5669.	3916.	668.	1540.
12	3170.	2834.	7297.	4499.	-957.	1170.
13	3171.	2937.	8686.	5000.	-2344.	874.
14	3172.	3035.	9833.	5418.	-3489.	652.
15	3172.	3127.	10739.	5754.	-4395.	501.
16	3172.	3213.	11401.	6006.	-5057.	420.
17	3171.	3291.	11817.	6174.	-5474.	408.
18	3171.	3361.	11986.	6259.	-5645.	463.
19	3170.	3423.	11907.	6260.	-5567.	586.
20	3168.	3476.	11576.	6177.	-5240.	774.

II.C.2.53

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 202   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	3983.		23469.	*	29735.	* *
2	3901.		19528.	*	25803.	*
3	3823.		15808.		22091.	*
4	3747.		12314.		18606.	
5	3676.		9049.		15349.	
6	3608.		6013.		12321.	
7	3544.		4014.		9524.	
8	3484.		2336.		6961.	
9	3429.		2513.		4629.	
10	3378.		3802.		2530.	
11	3333.		5669.		1540.	
12	3292.		7297.		2127.	
13	3257.		8686.		3218.	
14	3228.		9833.		4141.	
15	3204.		10739.		4896.	
16	3220.		11401.		5477.	
17	3293.		11817.		5882.	
18	3361.		11986.		6108.	
19	3424.		11907.		6153.	
20	3482.		11576.		6014.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.54

BODY NO. 105

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2688.	2547.	-4654.	-1392.	885.
2	2687.	2655.	-3319.	-964.	797.
3	2685.	2922.	-2119.	-585.	708.
4	2681.	3291.	-1055.	-255.	620.
5	2674.	3716.	-130.	28.	532.
6	2663.	4153.	659.	263.	443.
7	2649.	4568.	1308.	452.	355.
8	2632.	4928.	1819.	594.	267.
9	2612.	5211.	2190.	691.	179.
10	2591.	5398.	2420.	744.	90.
11	2568.	5478.	2507.	752.	1.
12	2544.	5445.	2451.	717.	-89.
13	2521.	5302.	2248.	638.	-180.
14	2500.	5056.	1896.	517.	-271.
15	2480.	4723.	1392.	352.	-365.
16	2464.	4325.	734.	146.	-459.
17	2451.	3893.	-83.	-102.	-556.
18	2441.	3463.	-1061.	-393.	-654.
19	2435.	3083.	-2206.	-724.	-753.
20	2433.	2805.	-3520.	-1096.	-854.

II.6.2.55

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 105

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5496E-01	-0.3881E-02	-0.8000E-03
2	0.5945E-01	-0.3843E-02	-0.5488E-02
3	0.7037E-01	-0.3823E-02	-0.8692E-02
4	0.8544E-01	-0.3832E-02	-0.1057E-01
5	0.1026E 00	-0.3879E-02	-0.1128E-01
6	0.1202E 00	-0.3966E-02	-0.1098E-01
7	0.1367E 00	-0.4093E-02	-0.9833E-02
8	0.1509E 00	-0.4256E-02	-0.7999E-02
9	0.1617E 00	-0.4449E-02	-0.5641E-02
10	0.1685E 00	-0.4664E-02	-0.2923E-02
11	0.1708E 00	-0.4891E-02	-0.1204E-04
12	0.1685E 00	-0.5120E-02	0.2925E-02
13	0.1616E 00	-0.5342E-02	0.5716E-02
14	0.1506E 00	-0.5545E-02	0.8188E-02
15	0.1361E 00	-0.5721E-02	0.1016E-01
16	0.1190E 00	-0.5863E-02	0.1146E-01
17	0.1007E 00	-0.5966E-02	0.1189E-01
18	0.8256E-01	-0.6029E-02	0.1126E-01
19	0.6659E-01	-0.6054E-02	0.9377E-02
20	0.5495E-01	-0.6047E-02	0.6043E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.56

BODY NO. 105

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3308.	3135.	-38994.	-9514.	45610.	15784.
2	3307.	3268.	-26855.	-5492.	33469.	12029.
3	3305.	3596.	-15951.	-1722.	22561.	8913.
4	3299.	4050.	-6293.	1736.	12892.	6365.
5	3290.	4573.	2113.	4826.	4467.	4321.
6	3277.	5112.	9263.	7502.	-2708.	2722.
7	3260.	5622.	15151.	9726.	-8630.	1518.
8	3239.	6066.	19771.	11465.	-13292.	666.
9	3215.	6414.	23117.	12697.	-16687.	130.
10	3188.	6644.	25180.	13405.	-18803.	-117.
11	3160.	6742.	25947.	13579.	-19627.	-95.
12	3131.	6702.	25404.	13217.	-19141.	186.
13	3103.	6525.	23531.	12326.	-17326.	724.
14	3076.	6222.	20308.	10918.	-14155.	1527.
15	3053.	5812.	15709.	9016.	-9603.	2609.
16	3032.	5323.	9705.	6650.	-3640.	3996.
17	3016.	4791.	2266.	3860.	3767.	5722.
18	3005.	4263.	-6641.	694.	12651.	7831.
19	2998.	3794.	-17051.	-2787.	23046.	10376.
20	2994.	3452.	-28996.	-6514.	34984.	13418.

II.6.2.57

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 105 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	4649.		38994.	* *	45610.	* *
2	4426.		26855.	*	33469.	* *
3	4214.		15951.		22561.	*
4	4409.		8029.		12892.	
5	4844.		4826.		4467.	
6	5305.		9263.		5430.	
7	5749.		15151.		10148.	
8	6139.		19771.	*	13958.	
9	6447.		23117.	*	16817.	
10	6652.		25180.	*	18803.	
11	6742.		25947.	*	19627.	*
12	6710.		25404.	*	19328.	*
13	6560.		23531.	*	18050.	
14	6302.		20308.	*	15682.	
15	5954.		15709.		12212.	
16	5544.		9705.		7636.	
17	5107.		3860.		5722.	
18	4687.		7336.		12651.	
19	4340.		17051.		23046.	*
20	4349.		28996.	* *	34984.	* *

II.6.2.58

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 106

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2797.	2436.	-4368.	-1314.	848.
2	2798.	2485.	-3089.	-908.	759.
3	2798.	2681.	-1948.	-550.	670.
4	2797.	2970.	-945.	-241.	581.
5	2794.	3308.	-82.	22.	492.
6	2789.	3655.	641.	237.	403.
7	2781.	3978.	1224.	407.	314.
8	2771.	4248.	1665.	530.	224.
9	2760.	4446.	1964.	609.	135.
10	2748.	4557.	2119.	643.	45.
11	2736.	4573.	2130.	633.	-45.
12	2723.	4493.	1994.	579.	-136.
13	2712.	4322.	1710.	481.	-228.
14	2702.	4073.	1275.	341.	-321.
15	2693.	3765.	687.	158.	-415.
16	2688.	3425.	-57.	-68.	-510.
17	2685.	3087.	-960.	-336.	-607.
18	2684.	2794.	-2025.	-647.	-705.
19	2685.	2594.	-3256.	-998.	-804.
20	2688.	2548.	-4654.	-1392.	-904.

II.6.2.59

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 106

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.5500E-01	-0.2852E-02	0.6367E-03
2	0.5716E-01	-0.2801E-02	-0.3744E-02
3	0.6526E-01	-0.2763E-02	-0.6706E-02
4	0.7717E-01	-0.2746E-02	-0.8410E-02
5	0.9098E-01	-0.2760E-02	-0.9018E-02
6	0.1051E 00	-0.2805E-02	-0.8693E-02
7	0.1180E 00	-0.2882E-02	-0.7598E-02
8	0.1288E 00	-0.2986E-02	-0.5896E-02
9	0.1365E 00	-0.3113E-02	-0.3756E-02
10	0.1405E 00	-0.3253E-02	-0.1343E-02
11	0.1407E 00	-0.3400E-02	0.1172E-02
12	0.1368E 00	-0.3543E-02	0.3620E-02
13	0.1293E 00	-0.3675E-02	0.5826E-02
14	0.1186E 00	-0.3787E-02	0.7613E-02
15	0.1056E 00	-0.3874E-02	0.8802E-02
16	0.9133E-01	-0.3929E-02	0.9208E-02
17	0.7726E-01	-0.3954E-02	0.8644E-02
18	0.6511E-01	-0.3948E-02	0.6920E-02
19	0.5690E-01	-0.3919E-02	0.3839E-02
20	0.5499E-01	-0.3878E-02	-0.7998E-03

II.6.2.60

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 106

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3443.	2998.	-36261.	-8942.	43146.	14937.
2	3444.	3059.	-24631.	-5193.	31519.	11311.
3	3444.	3300.	-14257.	-1703.	21145.	8302.
4	3443.	3656.	-5145.	1468.	12031.	5844.
5	3439.	4072.	2695.	4269.	4182.	3875.
6	3432.	4499.	9260.	6655.	-2396.	2343.
7	3423.	4896.	14544.	8591.	-7698.	1201.
8	3411.	5229.	18542.	10048.	-11720.	409.
9	3397.	5472.	21244.	11006.	-14449.	-61.
10	3382.	5609.	22642.	11452.	-15877.	-234.
11	3367.	5629.	22724.	11379.	-15991.	-122.
12	3352.	5530.	21477.	10790.	-14774.	270.
13	3337.	5320.	18881.	9696.	-12207.	944.
14	3325.	5013.	14916.	8112.	-8266.	1914.
15	3315.	4634.	9561.	6067.	-2931.	3200.
16	3308.	4215.	2791.	3595.	3825.	4835.
17	3304.	3799.	-5422.	742.	12030.	6857.
18	3303.	3438.	-15104.	-2438.	21711.	9315.
19	3305.	3193.	-26284.	-5882.	32894.	12268.
20	3308.	3136.	-38994.	-9513.	45610.	15785.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER.

BODY NO. 106 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	4653.		36261.	* *	43146.	* *
2	4440.		24631.	*	31519.	* *
3	4240.		14257.		21145.	*
4	4056.		6614.		12031.	
5	4297.		4269.		4182.	
6	4653.		9260.		4739.	
7	4991.		14544.		8899.	
8	5278.		18542.		12129.	
9	5491.		21244.	*	14449.	
10	5611.		22642.	*	15877.	
11	5631.		22724.	*	15991.	
12	5549.		21477.	*	15043.	
13	5372.		18881.		13151.	
14	5115.		14916.		10180.	
15	4802.		9561.		6132.	
16	4464.		3595.		4835.	
17	4143.		6164.		12030.	
18	4205.		15104.		21711.	*
19	4442.		26284.	*	32894.	* *
20	4699.		38994.	* *	45610.	* *

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.a

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 107

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2884.	2347.	-4408.	-1324.	853.
2	2885.	2414.	-3119.	-917.	764.
3	2886.	2628.	-1967.	-558.	675.
4	2886.	2936.	-955.	-247.	587.
5	2883.	3293.	-82.	18.	498.
6	2879.	3658.	650.	237.	409.
7	2873.	3998.	1242.	409.	320.
8	2865.	4284.	1694.	537.	232.
9	2855.	4496.	2004.	620.	143.
10	2845.	4618.	2171.	659.	54.
11	2834.	4642.	2196.	654.	-36.
12	2823.	4567.	2075.	606.	-126.
13	2813.	4397.	1808.	515.	-216.
14	2805.	4144.	1392.	381.	-308.
15	2798.	3826.	825.	204.	-401.
16	2793.	3470.	104.	-15.	-495.
17	2791.	3108.	-773.	-277.	-590.
18	2791.	2782.	-1809.	-581.	-687.
19	2794.	2539.	-3006.	-926.	-784.
20	2797.	2436.	-4368.	-1314.	-883.

II.6.2.63

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 107

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5500E-01	-0.1799E-02	0.2818E-03
2	0.5789E-01	-0.1740E-02	-0.4139E-02
3	0.6677E-01	-0.1696E-02	-0.7129E-02
4	0.7948E-01	-0.1676E-02	-0.8850E-02
5	0.9411E-01	-0.1687E-02	-0.9464E-02
6	0.1090E 00	-0.1733E-02	-0.9132E-02
7	0.1227E 00	-0.1811E-02	-0.8019E-02
8	0.1342E 00	-0.1918E-02	-0.6289E-02
9	0.1425E 00	-0.2048E-02	-0.4107E-02
10	0.1471E 00	-0.2194E-02	-0.1641E-02
11	0.1476E 00	-0.2346E-02	0.9450E-03
12	0.1441E 00	-0.2497E-02	0.3477E-02
13	0.1367E 00	-0.2636E-02	0.5786E-02
14	0.1259E 00	-0.2755E-02	0.7698E-02
15	0.1125E 00	-0.2848E-02	0.9033E-02
16	0.9765E-01	-0.2909E-02	0.9613E-02
17	0.8263E-01	-0.2936E-02	0.9252E-02
18	0.6915E-01	-0.2931E-02	0.7764E-02
19	0.5918E-01	-0.2899E-02	0.4959E-02
20	0.5501E-01	-0.2851E-02	0.6369E-03

II.6.2.6.4

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 107

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3549.	2889.	-36519.	-9143.	43617.	14920.
2	3551.	2971.	-24793.	-5366.	31896.	11308.
3	3552.	3234.	-14328.	-1841.	21432.	8310.
4	3552.	3614.	-5129.	1370.	12233.	5858.
5	3549.	4053.	2802.	4217.	4296.	3889.
6	3544.	4502.	9454.	6652.	-2366.	2353.
7	3536.	4920.	14827.	8640.	-7756.	1200.
8	3526.	5272.	18921.	10154.	-11869.	391.
9	3514.	5533.	21726.	11169.	-14697.	-103.
10	3501.	5684.	23237.	11674.	-16234.	-306.
11	3488.	5714.	23443.	11660.	-16467.	-232.
12	3475.	5621.	22333.	11130.	-15384.	113.
13	3463.	5412.	19892.	10091.	-12967.	733.
14	3452.	5100.	16100.	8560.	-9195.	1641.
15	3444.	4709.	10939.	6563.	-4051.	2856.
16	3438.	4271.	4385.	4132.	2491.	4410.
17	3435.	3826.	-3589.	1308.	10460.	6343.
18	3436.	3424.	-13002.	-1855.	19874.	8702.
19	3438.	3125.	-23883.	-5295.	30759.	11544.
20	3443.	2998.	-36261.	-8942.	43146.	14938.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II-6.2.65

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 107   DESIGN STRESS INTENSITY =   19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	4745.		36519.	* *	43617.	* *
2	4536.		24793.	*	31896.	* *
3	4340.		14328.		21432.	*
4	4160.		6499.		12233.	
5	4277.		4217.		4296.	
6	4656.		9454.		4719.	
7	5016.		14827.		8955.	
8	5324.		18921.		12261.	
9	5553.		21726.	*	14697.	
10	5686.		23237.	*	16234.	
11	5715.		23443.	*	16467.	
12	5637.		22333.	*	15496.	
13	5458.		19892.	*	13700.	
14	5192.		16100.		10836.	
15	4862.		10939.		6907.	
16	4499.		4385.		4410.	
17	4142.		4897.		10460.	
18	4270.		13002.		19874.	*
19	4496.		23883.	*	30759.	* *
20	4742.		36261.	* *	43146.	* *

II.6.2.66

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 108

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2944.	2285.	-4334.	-1301.	846.
2	2946.	2359.	-3053.	-899.	757.
3	2948.	2576.	-1912.	-545.	668.
4	2948.	2885.	-910.	-238.	580.
5	2946.	3240.	-48.	23.	491.
6	2943.	3601.	674.	238.	402.
7	2938.	3934.	1255.	409.	314.
8	2931.	4214.	1696.	534.	226.
9	2924.	4418.	1996.	615.	138.
10	2915.	4532.	2155.	653.	49.
11	2906.	4549.	2171.	647.	-40.
12	2898.	4467.	2042.	598.	-129.
13	2890.	4291.	1768.	506.	-219.
14	2883.	4034.	1347.	371.	-310.
15	2878.	3715.	776.	195.	-403.
16	2876.	3359.	53.	-25.	-496.
17	2875.	2999.	-824.	-286.	-590.
18	2876.	2677.	-1859.	-590.	-686.
19	2879.	2441.	-3052.	-936.	-782.
20	2884.	2347.	-4409.	-1324.	-880.

II.6.2.67

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 108

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5503E-01	-0.8864E-03	0.1192E-03
2	0.5821E-01	-0.8230E-03	-0.4220E-02
3	0.6726E-01	-0.7734E-03	-0.7138E-02
4	0.8002E-01	-0.7490E-03	-0.8799E-02
5	0.9458E-01	-0.7559E-03	-0.9364E-02
6	0.1093E 00	-0.7958E-03	-0.8997E-02
7	0.1229E 00	-0.8682E-03	-0.7861E-02
8	0.1341E 00	-0.9694E-03	-0.6120E-02
9	0.1422E 00	-0.1093E-02	-0.3940E-02
10	0.1465E 00	-0.1232E-02	-0.1487E-02
11	0.1469E 00	-0.1376E-02	0.1074E-02
12	0.1431E 00	-0.1517E-02	0.3572E-02
13	0.1356E 00	-0.1647E-02	0.5838E-02
14	0.1247E 00	-0.1757E-02	0.7698E-02
15	0.1113E 00	-0.1839E-02	0.8976E-02
16	0.9653E-01	-0.1890E-02	0.9495E-02
17	0.8168E-01	-0.1907E-02	0.9072E-02
18	0.6844E-01	-0.1892E-02	0.7522E-02
19	0.5879E-01	-0.1852E-02	0.4657E-02
20	0.5502E-01	-0.1795E-02	0.2824E-03

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.68
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 108

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3624.	2813.	-35763.	-9008.	43011.	14633.
2	3626.	2904.	-24125.	-5270.	31377.	11078.
3	3628.	3171.	-13751.	-1785.	21006.	8127.
4	3628.	3551.	-4646.	1389.	11902.	5714.
5	3626.	3988.	3186.	4198.	4066.	3778.
6	3622.	4432.	9743.	6599.	-2499.	2265.
7	3616.	4842.	15024.	8555.	-7792.	1129.
8	3608.	5186.	19025.	10039.	-11810.	333.
9	3598.	5437.	21744.	11028.	-14547.	-154.
10	3588.	5578.	23173.	11509.	-15997.	-354.
11	3577.	5599.	23305.	11476.	-16151.	-279.
12	3566.	5498.	22128.	10930.	-14995.	65.
13	3557.	5282.	19629.	9880.	-12516.	684.
14	3549.	4965.	15791.	8342.	-8694.	1589.
15	3543.	4572.	10596.	6340.	-3511.	2804.
16	3539.	4134.	4022.	3908.	3056.	4359.
17	3538.	3691.	-3953.	1088.	11030.	6295.
18	3540.	3295.	-13352.	-2069.	20432.	8660.
19	3544.	3005.	-24198.	-5503.	31286.	11512.
20	3549.	2889.	-36519.	-9143.	43617.	14920.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.69

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 108 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	4784.		35763.	* *	43011.	* *
2	4579.		24125.	*	31377.	* *
3	4388.		13751.		21006.	*
4	4212.		6035.		11902.	
5	4202.		4198.		4066.	
6	4578.		9743.		4764.	
7	4933.		15024.		8922.	
8	5234.		19025.		12143.	
9	5455.		21744.	*	14547.	
10	5580.		23173.	*	15997.	
11	5600.		23305.	*	16151.	
12	5514.		22128.	*	15061.	
13	5327.		19629.	*	13199.	
14	5056.		15791.		10283.	
15	4721.		10596.		6314.	
16	4356.		4022.		4359.	
17	4155.		5041.		11030.	
18	4352.		13352.		20432.	*
19	4572.		24198.	*	31286.	* *
20	4811.		36519.	* *	43617.	* *

II.6.2.70

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 109

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2985.	2245.	-4428.	-1331.	847.
2	2987.	2294.	-3144.	-930.	759.
3	2988.	2491.	-2000.	-576.	670.
4	2989.	2784.	-994.	-268.	582.
5	2988.	3125.	-129.	-6.	493.
6	2986.	3476.	598.	211.	405.
7	2982.	3802.	1184.	383.	317.
8	2977.	4077.	1629.	511.	229.
9	2971.	4279.	1935.	595.	142.
10	2964.	4395.	2099.	636.	54.
11	2957.	4415.	2121.	633.	-35.
12	2950.	4338.	2001.	588.	-124.
13	2944.	4169.	1735.	500.	-213.
14	2939.	3921.	1324.	369.	-303.
15	2936.	3611.	765.	196.	-395.
16	2934.	3265.	54.	-19.	-487.
17	2934.	2915.	-808.	-276.	-580.
18	2936.	2603.	-1825.	-576.	-675.
19	2940.	2374.	-2999.	-917.	-770.
20	2944.	2285.	-4334.	-1301.	-867.

II.6.2.71

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 109

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5502E-01	-0.1640E-03	0.8274E-03
2	0.5722E-01	-0.9596E-04	-0.3619E-02
3	0.6545E-01	-0.3940E-04	-0.6641E-02
4	0.7753E-01	-0.6497E-05	-0.8401E-02
5	0.9158E-01	-0.2742E-05	-0.9060E-02
6	0.1060E 00	-0.3189E-04	-0.8783E-02
7	0.1192E 00	-0.9280E-04	-0.7732E-02
8	0.1304E 00	-0.1813E-03	-0.6072E-02
9	0.1384E 00	-0.2924E-03	-0.3967E-02
10	0.1429E 00	-0.4181E-03	-0.1583E-02
11	0.1434E 00	-0.5502E-03	0.9167E-03
12	0.1400E 00	-0.6793E-03	0.3361E-02
13	0.1328E 00	-0.7975E-03	0.5581E-02
14	0.1224E 00	-0.8960E-03	0.7406E-02
15	0.1094E 00	-0.9686E-03	0.8662E-02
16	0.9510E-01	-0.1010E-02	0.9173E-02
17	0.8070E-01	-0.1019E-02	0.8758E-02
18	0.6788E-01	-0.9976E-03	0.7235E-02
19	0.5857E-01	-0.9505E-03	0.4419E-02
20	0.5502E-01	-0.8878E-03	0.1194E-03

II.6.2.72

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 109

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3674.	2763.	-36574.	-9338.	43921.	14863.
2	3676.	2824.	-24903.	-5633.	32255.	11281.
3	3678.	3066.	-14496.	-2170.	21852.	8303.
4	3679.	3426.	-5358.	990.	12715.	5862.
5	3678.	3846.	2509.	3793.	4846.	3899.
6	3675.	4278.	9108.	6198.	-1758.	2358.
7	3670.	4679.	14428.	8164.	-7088.	1195.
8	3664.	5018.	18474.	9664.	-11146.	372.
9	3657.	5267.	21241.	10675.	-13928.	-142.
10	3648.	5409.	22726.	11185.	-15429.	-368.
11	3640.	5433.	22920.	11187.	-15641.	-320.
12	3631.	5339.	21814.	10679.	-14552.	-1.
13	3624.	5132.	19396.	9672.	-12149.	591.
14	3618.	4826.	15652.	8180.	-8416.	1471.
15	3613.	4444.	10562.	6228.	-3336.	2660.
16	3611.	4018.	4106.	3846.	3117.	4190.
17	3611.	3588.	-3732.	1078.	10954.	6098.
18	3614.	3203.	-12974.	-2028.	20202.	8435.
19	3618.	2922.	-23643.	-5413.	30879.	11258.
20	3624.	2813.	-35763.	-9008.	43011.	14633.

II-6.2.73

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 109 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	4825.		36574.	* *	43921.	* *
2	4622.		24903.	*	32255.	* *
3	4433.		14496.		21852.	*
4	4260.		6348.		12715.	
5	4104.		3793.		4846.	
6	4424.		9108.		4115.	
7	4771.		14428.		8283.	
8	5066.		18474.		11518.	
9	5285.		21241.	*	13928.	
10	5411.		22726.	*	15429.	
11	5435.		22920.	*	15641.	
12	5353.		21814.	*	14552.	
13	5174.		19396.	*	12740.	
14	4910.		15652.		9887.	
15	4585.		10562.		5996.	
16	4229.		4106.		4190.	
17	4199.		4809.		10954.	
18	4390.		12974.		20202.	*
19	4602.		23643.	*	30879.	* *
20	4834.		35763.	* *	43011.	* *

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.14

BODY NO. 110

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	3033.	2196.	-3894.	-1161.	818.
2	3034.	2356.	-2655.	-777.	729.
3	3036.	2641.	-1555.	-439.	641.
4	3035.	3001.	-594.	-146.	554.
5	3034.	3392.	228.	101.	466.
6	3031.	3776.	912.	305.	379.
7	3026.	4120.	1457.	464.	292.
8	3021.	4400.	1864.	579.	205.
9	3014.	4596.	2131.	652.	119.
10	3007.	4696.	2259.	681.	32.
11	2999.	4693.	2247.	669.	-55.
12	2992.	4587.	2094.	614.	-143.
13	2986.	4385.	1798.	517.	-231.
14	2981.	4099.	1358.	379.	-320.
15	2977.	3750.	772.	198.	-410.
16	2975.	3365.	38.	-24.	-502.
17	2975.	2977.	-847.	-288.	-594.
18	2977.	2627.	-1885.	-594.	-687.
19	2981.	2364.	-3078.	-942.	-782.
20	2985.	2243.	-4428.	-1331.	-877.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.75

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 110

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5499E-01	0.8889E-03	-0.2252E-02
2	0.6173E-01	0.9565E-03	-0.6099E-02
3	0.7357E-01	0.1002E-02	-0.8573E-02
4	0.8842E-01	0.1019E-02	-0.9837E-02
5	0.1045E 00	0.9993E-03	-0.1005E-01
6	0.1201E 00	0.9441E-03	-0.9379E-02
7	0.1341E 00	0.8544E-03	-0.7981E-02
8	0.1454E 00	0.7362E-03	-0.6022E-02
9	0.1533E 00	0.5956E-03	-0.3663E-02
10	0.1571E 00	0.4412E-03	-0.1067E-02
11	0.1566E 00	0.2824E-03	0.1602E-02
12	0.1520E 00	0.1279E-03	0.4175E-02
13	0.1434E 00	-0.1121E-04	0.6488E-02
14	0.1314E 00	-0.1281E-03	0.8371E-02
15	0.1169E 00	-0.2153E-03	0.9652E-02
16	0.1009E 00	-0.2682E-03	0.1016E-01
17	0.8492E-01	-0.2848E-03	0.9708E-02
18	0.7057E-01	-0.2670E-03	0.8127E-02
19	0.5982E-01	-0.2204E-03	0.5230E-02
20	0.5498E-01	-0.1553E-03	0.8280E-03

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL

II:6.2.76

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 110

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3732.	2702.	-31655.	-7848.	39120.	13253.
2	3735.	2900.	-20396.	-4160.	27865.	9960.
3	3736.	3251.	-10397.	-736.	17869.	7238.
4	3736.	3694.	-1662.	2366.	9134.	5022.
5	3734.	4175.	5810.	5097.	1658.	3252.
6	3730.	4647.	12019.	7415.	-4559.	1879.
7	3725.	5071.	16968.	9284.	-9518.	857.
8	3718.	5415.	20654.	10679.	-13219.	152.
9	3709.	5657.	23078.	11579.	-15659.	-265.
10	3700.	5780.	24234.	11973.	-16833.	-413.
11	3691.	5776.	24116.	11855.	-16734.	-302.
12	3683.	5646.	22715.	11227.	-15350.	65.
13	3675.	5397.	20019.	10099.	-12670.	695.
14	3668.	5045.	16014.	8488.	-8677.	1603.
15	3664.	4616.	10682.	6418.	-3354.	2813.
16	3662.	4141.	4005.	3924.	3319.	4359.
17	3662.	3664.	-4039.	1046.	11362.	6282.
18	3664.	3233.	-13468.	-2166.	20797.	8632.
19	3669.	2909.	-24305.	-5650.	31642.	11469.
20	3674.	2761.	-36574.	-9340.	43922.	14862.

II-6-277

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 110 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	4800.		31655.	* *	39120.	* *
2	4605.		20396.	*	27865.	*
3	4424.		10397.		17869.	
4	4259.		4029.		9134.	
5	4364.		5810.		3252.	
6	4774.		12019.		6438.	
7	5147.		16968.		10376.	
8	5454.		20654.	*	13371.	
9	5670.		23078.	*	15659.	
10	5781.		24234.	*	16833.	
11	5779.		24116.	*	16734.	
12	5665.		22715.	*	15415.	
13	5446.		20019.	*	13365.	
14	5138.		16014.		10280.	
15	4766.		10682.		6167.	
16	4362.		4005.		4359.	
17	4268.		5085.		11362.	
18	4457.		13468.		20797.	*
19	4667.		24305.	*	31642.	* *
20	4897.		36574.	* *	43922.	* *

II.6.2.78

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 111

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	3014.	2207.	463.	166.	388.
2	3015.	2439.	865.	285.	326.
3	3016.	2653.	1198.	382.	264.
4	3017.	2841.	1462.	458.	202.
5	3017.	2997.	1657.	513.	140.
6	3017.	3116.	1783.	546.	78.
7	3016.	3197.	1840.	559.	16.
8	3016.	3237.	1827.	550.	-45.
9	3015.	3236.	1745.	521.	-108.
10	3015.	3197.	1592.	471.	-170.
11	3014.	3122.	1369.	400.	-232.
12	3015.	3016.	1075.	309.	-295.
13	3015.	2887.	710.	197.	-358.
14	3016.	2741.	272.	64.	-422.
15	3018.	2589.	-237.	-89.	-486.
16	3020.	2442.	-820.	-262.	-550.
17	3022.	2313.	-1477.	-457.	-614.
18	3025.	2218.	-2208.	-671.	-679.
19	3029.	2173.	-3013.	-906.	-744.
20	3032.	2195.	-3894.	-1161.	-810.

II.6.2.79

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 111

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.5500E-01	0.6375E-03	-0.8844E-02
2	0.6461E-01	0.6800E-03	-0.8303E-02
3	0.7345E-01	0.7083E-03	-0.7459E-02
4	0.8121E-01	0.7235E-03	-0.6369E-02
5	0.8764E-01	0.7278E-03	-0.5090E-02
6	0.9256E-01	0.7230E-03	-0.3678E-02
7	0.9585E-01	0.7117E-03	-0.2190E-02
8	0.9747E-01	0.6965E-03	-0.6822E-03
9	0.9742E-01	0.6803E-03	0.7876E-03
10	0.9577E-01	0.6649E-03	0.2162E-02
11	0.9267E-01	0.6539E-03	0.3384E-02
12	0.8832E-01	0.6483E-03	0.4394E-02
13	0.8299E-01	0.6505E-03	0.5135E-02
14	0.7702E-01	0.6617E-03	0.5548E-02
15	0.7081E-01	0.6822E-03	0.5572E-02
16	0.6483E-01	0.7128E-03	0.5148E-02
17	0.5961E-01	0.7519E-03	0.4215E-02
18	0.5578E-01	0.7992E-03	0.2712E-02
19	0.5399E-01	0.8509E-03	0.5770E-03
20	0.5500E-01	0.9033E-03	-0.2251E-02

II.6.2.80

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 111

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3710.	2717.	7916.	4221.	-497.	1212.
2	3711.	3002.	11569.	5588.	-4146.	416.
3	3712.	3265.	14598.	6737.	-7173.	-207.
4	3713.	3496.	16999.	7659.	-9573.	-666.
5	3713.	3688.	18774.	8348.	-11347.	-971.
6	3713.	3836.	19919.	8800.	-12494.	-1129.
7	3712.	3935.	20435.	9013.	-13010.	-1143.
8	3712.	3984.	20319.	8985.	-12896.	-1017.
9	3711.	3983.	19569.	8718.	-12147.	-752.
10	3710.	3935.	18182.	8215.	-10761.	-346.
11	3710.	3842.	16154.	7479.	-8734.	205.
12	3710.	3712.	13482.	6519.	-6062.	906.
13	3711.	3553.	10162.	5341.	-2740.	1764.
14	3712.	3373.	6188.	3957.	1237.	2789.
15	3714.	3186.	1556.	2378.	5873.	3994.
16	3717.	3005.	-3740.	620.	11173.	5391.
17	3720.	2847.	-9704.	-1302.	17144.	6996.
18	3724.	2730.	-16341.	-3368.	23789.	8828.
19	3728.	2674.	-23657.	-5558.	31113.	10906.
20	3732.	2701.	-31656.	-7849.	39120.	13252.

II.C.2.81

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 111   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	3976.		7916.		1709.	
2	3901.		11569.		4562.	
3	3838.		14598.		7173.	
4	3787.		16999.		9573.	
5	3749.		18774.		11347.	
6	3841.		19919.	*	12494.	
7	3935.		20435.	*	13010.	
8	3986.		20319.	*	12896.	
9	3994.		19569.	*	12147.	
10	3961.		18182.		10761.	
11	3891.		16154.		8939.	
12	3867.		13482.		6967.	
13	3940.		10162.		4504.	
14	4026.		6188.		2789.	
15	4124.		2378.		5873.	
16	4235.		4360.		11173.	
17	4357.		9704.		17144.	
18	4489.		16341.		23789.	*
19	4631.		23657.	*	31113.	* *
20	4782.		31656.	* *	39120.	* *

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL

II-6-2.82

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 112

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2991.	896.	-2830.	-838.	661.
2	2992.	932.	-2587.	-763.	641.
3	2994.	974.	-2353.	-690.	620.
4	2995.	1023.	-2125.	-620.	599.
5	2997.	1077.	-1906.	-553.	578.
6	2998.	1135.	-1694.	-488.	557.
7	3000.	1198.	-1490.	-425.	536.
8	3001.	1265.	-1293.	-365.	515.
9	3002.	1335.	-1105.	-307.	495.
10	3004.	1408.	-924.	-252.	474.
11	3005.	1484.	-750.	-199.	453.
12	3006.	1561.	-585.	-149.	432.
13	3007.	1640.	-427.	-101.	411.
14	3008.	1720.	-277.	-56.	390.
15	3009.	1801.	-134.	-13.	370.
16	3010.	1883.	1.	28.	349.
17	3011.	1965.	128.	66.	328.
18	3012.	2046.	247.	101.	307.
19	3012.	2127.	359.	135.	287.
20	3013.	2207.	463.	166.	266.

II 6.2.83

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 112

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	-0.2861E-04	0.9477E-05	-0.3853E-02
2	0.1525E-02	0.5400E-04	-0.4595E-02
3	0.3351E-02	0.9829E-04	-0.5272E-02
4	0.5416E-02	0.1407E-03	-0.5886E-02
5	0.7705E-02	0.1827E-03	-0.6440E-02
6	0.1019E-01	0.2230E-03	-0.6935E-02
7	0.1284E-01	0.2623E-03	-0.7372E-02
8	0.1567E-01	0.3001E-03	-0.7755E-02
9	0.1861E-01	0.3361E-03	-0.8085E-02
10	0.2167E-01	0.3712E-03	-0.8365E-02
11	0.2484E-01	0.4045E-03	-0.8597E-02
12	0.2808E-01	0.4361E-03	-0.8781E-02
13	0.3138E-01	0.4657E-03	-0.8922E-02
14	0.3473E-01	0.4937E-03	-0.9021E-02
15	0.3811E-01	0.5202E-03	-0.9079E-02
16	0.4150E-01	0.5448E-03	-0.9100E-02
17	0.4490E-01	0.5681E-03	-0.9085E-02
18	0.4829E-01	0.5890E-03	-0.9036E-02
19	0.5165E-01	0.6083E-03	-0.8955E-02
20	0.5497E-01	0.6260E-03	-0.8844E-02

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.84

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 112

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	3681.	1103.	-22038.	-6509.	29399.	8715.
2	3683.	1147.	-19833.	-5784.	27198.	8078.
3	3685.	1199.	-17697.	-5073.	25066.	7472.
4	3687.	1259.	-15632.	-4378.	23005.	6895.
5	3688.	1325.	-13631.	-3697.	21008.	6347.
6	3690.	1397.	-11706.	-3034.	19086.	5828.
7	3692.	1475.	-9850.	-2388.	17234.	5338.
8	3694.	1557.	-8060.	-1759.	15447.	4873.
9	3695.	1643.	-6345.	-1149.	13735.	4436.
10	3697.	1733.	-4699.	-558.	12093.	4025.
11	3698.	1826.	-3120.	14.	10517.	3638.
12	3700.	1921.	-1615.	566.	9014.	3277.
13	3701.	2019.	-179.	1098.	7581.	2940.
14	3702.	2117.	1189.	1610.	6215.	2625.
15	3704.	2217.	2484.	2099.	4923.	2335.
16	3705.	2317.	3710.	2568.	3700.	2067.
17	3706.	2418.	4868.	3015.	2544.	1821.
18	3707.	2518.	5953.	3439.	1461.	1597.
19	3708.	2618.	6968.	3841.	447.	1394.
20	3708.	2716.	7915.	4221.	-498.	1212.

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.85
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 112 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	4417.		22038.	*	29399.	* *
2	4377.		19833.	*	27198.	*
3	4337.		17697.		25066.	*
4	4299.		15632.		23005.	*
5	4261.		13631.		21008.	*
6	4225.		11706.		19086.	
7	4189.		9850.		17234.	
8	4155.		8060.		15447.	
9	4122.		6345.		13735.	
10	4090.		4699.		12093.	
11	4059.		3134.		10517.	
12	4029.		2181.		9014.	
13	4000.		1277.		7581.	
14	3973.		1610.		6215.	
15	3947.		2484.		4923.	
16	3922.		3710.		3700.	
17	3899.		4868.		2544.	
18	3877.		5953.		1597.	
19	3856.		6968.		1394.	
20	3836.		7915.		1710.	

II.6.2.36

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 204

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2404.	2831.	386.	110.	237.
2	2401.	2809.	560.	160.	190.
3	2399.	2782.	697.	198.	144.
4	2397.	2748.	797.	225.	97.
5	2396.	2705.	859.	239.	50.
6	2394.	2653.	883.	243.	3.
7	2393.	2591.	869.	234.	-45.
8	2393.	2520.	816.	214.	-93.
9	2392.	2440.	724.	183.	-141.
10	2392.	2352.	593.	141.	-190.
11	2393.	2258.	422.	87.	-239.
12	2394.	2160.	210.	22.	-288.
13	2396.	2059.	-41.	-55.	-338.
14	2398.	1960.	-335.	-142.	-387.
15	2401.	1865.	-669.	-240.	-438.
16	2404.	1778.	-1046.	-350.	-488.
17	2408.	1704.	-1465.	-470.	-539.
18	2412.	1648.	-1927.	-600.	-590.
19	2417.	1615.	-2432.	-742.	-642.
20	2422.	1611.	-2981.	-894.	-694.

II.6.2.87

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 204

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.5497E-01	-0.5787E-02	0.8476E-03
2	0.5401E-01	-0.5779E-02	0.1129E-02
3	0.5281E-01	-0.5770E-02	0.1503E-02
4	0.5133E-01	-0.5759E-02	0.1947E-02
5	0.4949E-01	-0.5746E-02	0.2440E-02
6	0.4730E-01	-0.5732E-02	0.2958E-02
7	0.4471E-01	-0.5715E-02	0.3480E-02
8	0.4174E-01	-0.5694E-02	0.3984E-02
9	0.3843E-01	-0.5670E-02	0.4446E-02
10	0.3482E-01	-0.5642E-02	0.4842E-02
11	0.3096E-01	-0.5610E-02	0.5151E-02
12	0.2694E-01	-0.5574E-02	0.5347E-02
13	0.2285E-01	-0.5533E-02	0.5406E-02
14	0.1883E-01	-0.5487E-02	0.5306E-02
15	0.1502E-01	-0.5437E-02	0.5020E-02
16	0.1157E-01	-0.5382E-02	0.4524E-02
17	0.8658E-02	-0.5324E-02	0.3794E-02
18	0.6495E-02	-0.5262E-02	0.2803E-02
19	0.5301E-02	-0.5198E-02	0.1525E-02
20	0.5317E-02	-0.5134E-02	-0.6692E-04

II.62.88

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 204

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	2958.	3484.	6468.	4480.	-552.	2487.
2	2956.	3458.	8046.	4909.	-2135.	2006.
3	2953.	3424.	9288.	5224.	-3382.	1625.
4	2951.	3382.	10192.	5423.	-4291.	1342.
5	2949.	3329.	10754.	5505.	-4857.	1154.
6	2947.	3265.	10972.	5470.	-5078.	1060.
7	2946.	3189.	10842.	5319.	-4951.	1060.
8	2945.	3102.	10361.	5051.	-4471.	1152.
9	2944.	3003.	9526.	4669.	-3637.	1338.
10	2944.	2895.	8333.	4174.	-2444.	1617.
11	2945.	2779.	6779.	3568.	-888.	1991.
12	2947.	2658.	4859.	2855.	1034.	2461.
13	2949.	2534.	2572.	2038.	3326.	3031.
14	2952.	2412.	-92.	1121.	5995.	3703.
15	2955.	2295.	-3130.	110.	9040.	4480.
16	2959.	2188.	-6548.	-990.	12466.	5366.
17	2964.	2097.	-10351.	-2172.	16279.	6366.
18	2969.	2028.	-14543.	-3430.	20482.	7486.
19	2975.	1987.	-19128.	-4755.	25078.	8730.
20	2981.	1983.	-24116.	-6141.	30078.	10107.

II-6-2-89

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 204 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	3547.		6468.		3039.	
2	3499.		8046.		4141.	
3	3448.		9288.		5007.	
4	3393.		10192.		5632.	
5	3332.		10754.		6011.	
6	3265.		10972.		6138.	
7	3192.		10842.		6011.	
8	3112.		10361.		5624.	
9	3026.		9526.		4975.	
10	3027.		8333.		4061.	
11	3074.		6779.		2879.	
12	3133.		4859.		2461.	
13	3201.		2572.		3326.	
14	3280.		1213.		5995.	
15	3368.		3240.		9040.	
16	3465.		6548.		12466.	
17	3571.		10351.		16279.	
18	3684.		14543.		20482.	*
19	3804.		19128.		25078.	*
20	3931.		24116.	*	30078.	* *

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.90

BODY NO. 200

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	2433.	2805.	-3520.	-1096.	690.
2	2431.	2696.	-2991.	-925.	645.
3	2429.	2622.	-2497.	-766.	601.
4	2428.	2578.	-2037.	-619.	556.
5	2427.	2557.	-1612.	-484.	511.
6	2426.	2555.	-1222.	-362.	465.
7	2425.	2569.	-868.	-251.	420.
8	2424.	2593.	-550.	-153.	374.
9	2423.	2625.	-268.	-67.	328.
10	2421.	2661.	-22.	8.	282.
11	2420.	2698.	188.	71.	236.
12	2419.	2734.	360.	121.	190.
13	2417.	2767.	496.	160.	143.
14	2415.	2795.	594.	188.	96.
15	2413.	2817.	655.	203.	49.
16	2411.	2833.	678.	207.	2.
17	2409.	2842.	663.	200.	-45.
18	2407.	2844.	610.	181.	-93.
19	2405.	2840.	518.	151.	-140.
20	2403.	2831.	386.	110.	-189.

II.6.2.91

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 200

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5499E-01	-0.6043E-02	0.6043E-02
2	0.5046E-01	-0.6031E-02	0.4135E-02
3	0.4739E-01	-0.6015E-02	0.2526E-02
4	0.4552E-01	-0.5997E-02	0.1195E-02
5	0.4464E-01	-0.5977E-02	0.1226E-03
6	0.4456E-01	-0.5956E-02	-0.7104E-03
7	0.4509E-01	-0.5936E-02	-0.1325E-02
8	0.4607E-01	-0.5916E-02	-0.1744E-02
9	0.4733E-01	-0.5898E-02	-0.1985E-02
10	0.4876E-01	-0.5882E-02	-0.2072E-02
11	0.5024E-01	-0.5867E-02	-0.2024E-02
12	0.5165E-01	-0.5855E-02	-0.1863E-02
13	0.5294E-01	-0.5843E-02	-0.1612E-02
14	0.5402E-01	-0.5833E-02	-0.1291E-02
15	0.5486E-01	-0.5824E-02	-0.9226E-03
16	0.5542E-01	-0.5816E-02	-0.5292E-03
17	0.5570E-01	-0.5809E-02	-0.1325E-03
18	0.5570E-01	-0.5802E-02	0.2442E-03
19	0.5545E-01	-0.5795E-02	0.5785E-03
20	0.5499E-01	-0.5787E-02	0.8478E-03

II.C.2.92

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 200

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	2994.	3452.	-28996.	-6513.	34984.	13418.
2	2992.	3318.	-24192.	-5090.	30175.	11727.
3	2990.	3227.	-19701.	-3735.	25680.	10190.
4	2988.	3172.	-15524.	-2455.	21501.	8800.
5	2987.	3147.	-11662.	-1255.	17636.	7549.
6	2986.	3145.	-8124.	-143.	14095.	6434.
7	2985.	3162.	-4909.	877.	10878.	5447.
8	2983.	3192.	-2015.	1802.	7982.	4582.
9	2982.	3231.	547.	2626.	5416.	3836.
10	2980.	3275.	2781.	3347.	3180.	3203.
11	2979.	3321.	4684.	3962.	1273.	2680.
12	2977.	3365.	6251.	4467.	-298.	2263.
13	2975.	3405.	7482.	4861.	-1533.	1949.
14	2972.	3440.	8375.	5144.	-2430.	1736.
15	2970.	3467.	8925.	5314.	-2985.	1621.
16	2968.	3487.	9132.	5371.	-3197.	1603.
17	2965.	3498.	8993.	5315.	-3062.	1681.
18	2963.	3500.	8504.	5147.	-2579.	1854.
19	2960.	3495.	7664.	4868.	-1743.	2123.
20	2958.	3484.	6468.	4481.	-552.	2488.

II.6.293

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 200   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	3931.		28996.	* *	34984.	* *
2	3825.		24192.	*	30175.	* *
3	3723.		19701.	*	25680.	*
4	3625.		15524.		21501.	*
5	3532.		11662.		17636.	
6	3445.		8124.		14095.	
7	3363.		5786.		10878.	
8	3344.		3818.		7982.	
9	3349.		2626.		5416.	
10	3363.		3347.		3203.	
11	3383.		4684.		2680.	
12	3406.		6251.		2561.	
13	3429.		7482.		3482.	
14	3451.		8375.		4165.	
15	3470.		8925.		4606.	
16	3487.		9132.		4800.	
17	3500.		8993.		4743.	
18	3510.		8504.		4433.	
19	3518.		7664.		3866.	
20	3525.		6468.		3040.	

II.6.2.94

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 201

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-1362.	613.	204.	61.	-41.
2	-1362.	543.	63.	19.	-23.
3	-1362.	363.	-9.	-3.	-10.
4	-1362.	190.	-34.	-10.	-2.
5	-1362.	70.	-34.	-10.	2.
6	-1362.	4.	-25.	-7.	3.
7	-1362.	-23.	-14.	-4.	2.
8	-1362.	-27.	-6.	-2.	1.
9	-1362.	-21.	-2.	-0.	1.
10	-1362.	-13.	0.	0.	0.
11	-1362.	-4.	0.	0.	-0.
12	-1362.	5.	-0.	-0.	-0.
13	-1362.	15.	0.	0.	0.
14	-1362.	24.	2.	1.	1.
15	-1362.	28.	7.	2.	2.
16	-1362.	21.	16.	5.	2.
17	-1362.	-13.	27.	8.	3.
18	-1362.	-91.	36.	11.	1.
19	-1362.	-225.	33.	10.	-3.
20	-1362.	-409.	0.	0.	-12.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II-6.295

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 201

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.5937E-02	0.4437E-02	-0.6726E-04
2	0.5531E-02	0.4176E-02	0.2008E-03
3	0.4481E-02	0.3921E-02	0.2472E-03
4	0.3481E-02	0.3677E-02	0.1952E-03
5	0.2782E-02	0.3439E-02	0.1201E-03
6	0.2396E-02	0.3207E-02	0.5737E-04
7	0.2239E-02	0.2976E-02	0.1713E-04
8	0.22[illegible]E-02	0.2747E-02	-0.3295E-05
9	0.2250E-02	0.2517E-02	-0.1079E-04
10	0.2301E-02	0.2287E-02	-0.1203E-04
11	0.2354E-02	0.2057E-02	-0.1164E-04
12	0.2406E-02	0.1826E-02	-0.1180E-04
13	0.2459E-02	0.1594E-02	-0.1227E-04
14	0.2511E-02	0.1362E-02	-0.1030E-04
15	0.2539E-02	0.1130E-02	-0.7254E-06
16	0.2496E-02	0.8979E-03	0.2354E-04
17	0.2299E-02	0.6666E-03	0.6921E-04
18	0.1848E-02	0.4381E-03	0.1373E-03
19	0.1067E-02	0.2149E-03	0.2139E-03
20	0.4883E-08	-0.2776E-10	0.2557E-03

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II-6.2.96

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 201

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-1453.	654.	-57.	1072.	-2848.	235.
2	-1453.	579.	-1022.	708.	-1883.	450.
3	-1453.	387.	-1515.	368.	-1390.	405.
4	-1453.	203.	-1687.	133.	-1218.	273.
5	-1453.	75.	-1687.	5.	-1219.	145.
6	-1453.	4.	-1620.	-46.	-1285.	54.
7	-1453.	-25.	-1548.	-53.	-1358.	4.
8	-1453.	-29.	-1494.	-42.	-1411.	-17.
9	-1453.	-23.	-1464.	-26.	-1442.	-20.
10	-1453.	-13.	-1452.	-13.	-1453.	-14.
11	-1453.	-4.	-1452.	-3.	-1454.	-4.
12	-1453.	6.	-1455.	5.	-1451.	6.
13	-1453.	16.	-1452.	16.	-1453.	15.
14	-1453.	25.	-1437.	30.	-1468.	21.
15	-1453.	30.	-1402.	46.	-1503.	15.
16	-1453.	22.	-1342.	55.	-1563.	-11.
17	-1453.	-14.	-1266.	42.	-1639.	-70.
18	-1453.	-97.	-1205.	-22.	-1701.	-171.
19	-1453.	-240.	-1227.	-172.	-1678.	-308.
20	-1453.	-436.	-1453.	-436.	-1453.	-436.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.97

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 201   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	2110.		1130.		3083.	
2	2033.		1731.		2333.	
3	1840.		1883.		1796.	
4	1656.		1820.		1492.	
5	1528.		1691.		1364.	
6	1457.		1620.		1339.	
7	1453.		1548.		1361.	
8	1453.		1494.		1411.	
9	1453.		1464.		1442.	
10	1453.		1452.		1453.	
11	1453.		1452.		1454.	
12	1458.		1460.		1457.	
13	1468.		1468.		1468.	
14	1478.		1467.		1488.	
15	1483.		1448.		1519.	
16	1475.		1398.		1563.	
17	1453.		1308.		1639.	
18	1453.		1205.		1701.	
19	1453.		1227.		1678.	
20	1453.		1453.		1453.	

II.6.2.98

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 203

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-0.	-57.	0.	-0.	0.
2	-0.	-57.	-1.	-0.	-1.
3	-0.	-57.	-3.	-1.	-1.
4	-0.	-56.	-6.	-2.	-2.
5	-0.	-53.	-11.	-3.	-3.
6	-0.	-47.	-17.	-5.	-3.
7	-0.	-36.	-24.	-7.	-4.
8	-0.	-18.	-31.	-9.	-4.
9	-0.	9.	-40.	-12.	-4.
10	-0.	47.	-48.	-14.	-4.
11	-0.	100.	-54.	-16.	-3.
12	-0.	168.	-59.	-18.	-1.
13	-0.	254.	-59.	-18.	1.
14	-0.	357.	-54.	-16.	5.
15	-0.	475.	-40.	-12.	10.
16	-0.	605.	-15.	-4.	17.
17	-0.	739.	25.	7.	25.
18	-0.	865.	82.	24.	35.
19	-0.	967.	159.	48.	47.
20	-0.	1022.	259.	78.	59.

II.6.2.99

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. +.S.C. WATER

BODY NO. 203

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	-0.3300E-03	0.4540E-02	0.1866E-06
2	-0.3302E-03	0.4541E-02	-0.1409E-07
3	-0.3291E-03	0.4542E-02	-0.1419E-05
4	-0.3233E-03	0.4543E-02	-0.5232E-05
5	-0.3071E-03	0.4545E-02	-0.1264E-04
6	-0.2724E-03	0.4546E-02	-0.2481E-04
7	-0.2095E-03	0.4547E-02	-0.4277E-04
8	-0.1063E-03	0.4547E-02	-0.6743E-04
9	0.5046E-04	0.4547E-02	-0.9934E-04
10	0.2746E-03	0.4547E-02	-0.1386E-03
11	0.5797E-03	0.4545E-02	-0.1847E-03
12	0.9773E-03	0.4542E-02	-0.2359E-03
13	0.1475E-02	0.4538E-02	-0.2896E-03
14	0.2073E-02	0.4531E-02	-0.3411E-03
15	0.2761E-02	0.4522E-02	-0.3841E-03
16	0.3516E-02	0.4510E-02	-0.4096E-03
17	0.4294E-02	0.4496E-02	-0.4063E-03
18	0.5027E-02	0.4478E-02	-0.3599E-03
19	0.5619E-02	0.4458E-02	-0.2534E-03
20	0.5937E-02	0.4437E-02	-0.6726E-04

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 203

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-0.	-61.	0.	-61.	-0.	-61.
2	-0.	-61.	-5.	-62.	5.	-59.
3	-0.	-60.	-18.	-66.	18.	-55.
4	-0.	-59.	-41.	-72.	41.	-47.
5	-0.	-56.	-73.	-78.	73.	-35.
6	-0.	-50.	-113.	-84.	113.	-16.
7	-0.	-38.	-161.	-87.	161.	10.
8	-0.	-20.	-214.	-84.	214.	45.
9	-0.	9.	-270.	-72.	270.	90.
10	-0.	50.	-325.	-47.	325.	148.
11	-0.	106.	-372.	-5.	372.	218.
12	-0.	179.	-403.	59.	403.	300.
13	-0.	271.	-406.	149.	406.	392.
14	-0.	380.	-368.	270.	368.	491.
15	-0.	507.	-273.	425.	273.	589.
16	-0.	645.	-101.	615.	101.	676.
17	-0.	788.	169.	839.	-169.	738.
18	-0.	923.	557.	1090.	-557.	756.
19	-0.	1031.	1085.	1357.	-1085.	706.
20	-0.	1090.	1767.	1620.	-1767.	560.

II.6.2.101

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 203 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	61.		61.		61.	
2	62.		62.		64.	
3	63.		66.		73.	
4	63.		72.		88.	
5	61.		78.		107.	
6	55.		113.		129.	
7	45.		161.		161.	
8	26.		214.		214.	
9	16.		270.		270.	
10	57.		325.		325.	
11	111.		372.		372.	
12	182.		461.		403.	
13	273.		555.		406.	
14	388.		638.		491.	
15	523.		698.		589.	
16	672.		716.		676.	
17	828.		839.		906.	
18	979.		1090.		1313.	
19	1106.		1357.		1791.	
20	1184.		1767.		2327.	

II.6.2.102

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 302

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	12264.	5449.	-1042.	-330.	285.
2	12278.	5300.	-793.	-254.	246.
3	12293.	5163.	-581.	-189.	207.
4	12308.	5035.	-406.	-135.	167.
5	12324.	4913.	-268.	-93.	127.
6	12340.	4795.	-168.	-63.	87.
7	12356.	4679.	-105.	-44.	47.
8	12373.	4565.	-81.	-36.	6.
9	12390.	4452.	-94.	-40.	-35.
10	12408.	4340.	-146.	-56.	-75.
11	12425.	4230.	-237.	-83.	-116.
12	12444.	4124.	-366.	-121.	-158.
13	12462.	4023.	-535.	-171.	-199.
14	12481.	3931.	-743.	-232.	-241.
15	12500.	3850.	-991.	-304.	-282.
16	12520.	3785.	-1278.	-388.	-324.
17	12539.	3739.	-1605.	-484.	-366.
18	12559.	3719.	-1973.	-590.	-408.
19	12580.	3731.	-2381.	-708.	-450.
20	12600.	3780.	-2830.	-837.	-493.

II-6.2.103

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 302

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.5501E-01	-0.8439E-02	0.6166E-02
2	0.4947E-01	-0.8049E-02	0.5540E-02
3	0.4445E-01	-0.7651E-02	0.5074E-02
4	0.3981E-01	-0.7246E-02	0.4739E-02
5	0.3544E-01	-0.6834E-02	0.4513E-02
6	0.3125E-01	-0.6416E-02	0.4368E-02
7	0.2717E-01	-0.5992E-02	0.4279E-02
8	0.2315E-01	-0.5561E-02	0.4220E-02
9	0.1920E-01	-0.5124E-02	0.4165E-02
10	0.1531E-01	-0.4681E-02	0.4087E-02
11	0.1152E-01	-0.4232E-02	0.3960E-02
12	0.7888E-02	-0.3777E-02	0.3758E-02
13	0.4502E-02	-0.3317E-02	0.3452E-02
14	0.1467E-02	-0.2851E-02	0.3017E-02
15	-0.1081E-02	-0.2380E-02	0.2426E-02
16	-0.2984E-02	-0.1906E-02	0.1650E-02
17	-0.4054E-02	-0.1429E-02	0.6618E-03
18	-0.4075E-02	-0.9497E-03	-0.5656E-03
19	-0.2808E-02	-0.4704E-03	-0.2060E-02
20	0.8345E-05	0.8106E-05	-0.3852E-02

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.104

BODY NO. 302

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	15094.	6707.	5620.	3707.	24568.	9706.
2	15112.	6523.	7900.	4217.	22324.	8828.
3	15130.	6354.	9847.	4639.	20414.	8070.
4	15149.	6197.	11457.	4967.	18841.	7426.
5	15168.	6046.	12729.	5198.	17607.	6895.
6	15188.	5901.	13661.	5330.	16714.	6472.
7	15208.	5759.	14250.	5360.	16165.	6157.
8	15228.	5618.	14495.	5288.	15962.	5948.
9	15249.	5479.	14393.	5113.	16106.	5845.
10	15271.	5341.	13942.	4836.	16599.	5847.
11	15293.	5206.	13140.	4456.	17446.	5956.
12	15315.	5075.	11985.	3977.	18646.	6174.
13	15338.	4952.	10474.	3401.	20202.	6502.
14	15361.	4838.	8607.	2732.	22116.	6944.
15	15385.	4738.	6380.	1973.	24390.	7504.
16	15409.	4658.	3792.	1129.	27026.	8187.
17	15433.	4602.	841.	207.	30025.	8998.
18	15458.	4578.	-2474.	-787.	33390.	9942.
19	15483.	4592.	-6156.	-1845.	37121.	11028.
20	15507.	4652.	-10209.	-2960.	41224.	12263.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 302   DESIGN STRESS INTENSITY =   19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	15131.		5620.		24568.	*
2	15139.		7900.		22324.	*
3	15149.		9847.		20414.	*
4	15161.		11457.		18841.	
5	15175.		12729.		17607.	
6	15191.		13661.		16714.	
7	15209.		14250.		16165.	
8	15228.		14495.		15962.	
9	15250.		14393.		16106.	
10	15273.		13942.		16599.	
11	15299.		13140.		17446.	
12	15326.		11985.		18646.	
13	15356.		10474.		20202.	*
14	15387.		8607.		22116.	*
15	15420.		6380.		24390.	*
16	15455.		3792.		27026.	*
17	15492.		841.		30025.	* *
18	15531.		2474.		33390.	* *
19	15572.		6156.		37121.	* *
20	15614.		10209.		41224.	* *

II.6.2.106

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 300

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	12037.	5947.	1295.	415.	234.
2	12048.	6151.	1499.	474.	195.
3	12060.	6331.	1667.	521.	157.
4	12071.	6486.	1799.	558.	118.
5	12083.	6613.	1895.	583.	80.
6	12094.	6710.	1955.	598.	42.
7	12105.	6777.	1980.	601.	4.
8	12116.	6813.	1968.	594.	-35.
9	12127.	6819.	1920.	576.	-73.
10	12138.	6794.	1836.	547.	-112.
11	12149.	6740.	1715.	508.	-150.
12	12160.	6659.	1558.	457.	-189.
13	12172.	6553.	1364.	397.	-228.
14	12184.	6426.	1133.	325.	-267.
15	12197.	6281.	865.	242.	-306.
16	12210.	6122.	560.	149.	-345.
17	12223.	5953.	217.	46.	-385.
18	12237.	5781.	-164.	-69.	-425.
19	12251.	5611.	-584.	-194.	-465.
20	12266.	5450.	-1042.	-330.	-506.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 300

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.6641E-01	-0.1480E-01	-0.9899E-02
2	0.7525E-01	-0.1444E-01	-0.8943E-02
3	0.8314E-01	-0.1410E-01	-0.7858E-02
4	0.8996E-01	-0.1377E-01	-0.6669E-02
5	0.9563E-01	-0.1344E-01	-0.5403E-02
6	0.1001E 00	-0.1312E-01	-0.4080E-02
7	0.1033E 00	-0.1280E-01	-0.2728E-02
8	0.1052E 00	-0.1249E-01	-0.1371E-02
9	0.1058E 00	-0.1218E-01	-0.3443E-04
10	0.1053E 00	-0.1187E-01	0.1259E-02
11	0.1035E 00	-0.1155E-01	0.2482E-02
12	0.1006E 00	-0.1124E-01	0.3611E-02
13	0.9674E-01	-0.1091E-01	0.4619E-02
14	0.9199E-01	-0.1058E-01	0.5482E-02
15	0.8650E-01	-0.1025E-01	0.6175E-02
16	0.8046E-01	-0.9900E-02	0.6671E-02
17	0.7406E-01	-0.9546E-02	0.6944E-02
18	0.6752E-01	-0.9183E-02	0.6969E-02
19	0.6109E-01	-0.8810E-02	0.6718E-02
20	0.5504E-01	-0.8428E-02	0.6165E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.C.2.108

BODY NO. 300

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	14814.	7320.	26583.	11092.	3045.	3548.
2	14829.	7570.	28452.	11875.	1206.	3265.
3	14843.	7792.	29995.	12530.	-308.	3054.
4	14857.	7983.	31210.	13052.	-1495.	2913.
5	14871.	8139.	32096.	13439.	-2355.	2838.
6	14885.	8259.	32657.	13691.	-2888.	2826.
7	14898.	8341.	32890.	13806.	-3094.	2876.
8	14911.	8386.	32796.	13785.	-2973.	2986.
9	14925.	8392.	32374.	13628.	-2524.	3156.
10	14939.	8361.	31622.	13335.	-1745.	3388.
11	14953.	8295.	30540.	12909.	-635.	3681.
12	14967.	8196.	29126.	12353.	807.	4038.
13	14981.	8066.	27380.	11669.	2582.	4462.
14	14996.	7909.	25297.	10861.	4695.	4957.
15	15012.	7730.	22876.	9934.	7147.	5527.
16	15027.	7534.	20115.	8892.	9940.	6177.
17	15044.	7327.	17014.	7742.	13073.	6912.
18	15061.	7115.	13566.	6489.	16556.	7741.
19	15079.	6906.	9770.	5142.	20388.	8670.
20	15097.	6708.	5623.	3708.	24571.	9708.

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.109
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 300   DESIGN STRESS INTENSITY =   19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	14839.		26583.	*	3548.	
2	14846.		28452.	*	3265.	
3	14854.		29995.	* *	3363.	
4	14864.		31210.	* *	4408.	
5	14874.		32096.	* *	5193.	
6	14885.		32657.	* *	5714.	
7	14898.		32890.	* *	5970.	
8	14912.		32796.	* *	5959.	
9	14927.		32374.	* *	5680.	
10	14944.		31622.	* *	5133.	
11	14963.		30540.	* *	4316.	
12	14983.		29126.	* *	4038.	
13	15005.		27380.	*	4462.	
14	15028.		25297.	*	4957.	
15	15054.		22876.	*	7147.	
16	15081.		20115.	*	9940.	
17	15111.		17014.		13073.	
18	15142.		13566.		16556.	
19	15176.		9770.		20388.	*
20	15212.		5623.		24571.	*

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.110

BODY NO. 301

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	1947.	3607.	904.	271.	-117.
2	1947.	2459.	24.	7.	-38.
3	1947.	761.	-157.	-47.	-0.
4	1947.	-20.	-97.	-29.	7.
5	1947.	-156.	-27.	-8.	4.
6	1947.	-88.	2.	1.	1.
7	1947.	-22.	7.	2.	-0.
8	1947.	4.	3.	1.	-0.
9	1947.	6.	1.	0.	-0.
10	1947.	3.	-0.	-0.	-0.
11	1947.	1.	-0.	-0.	0.
12	1947.	0.	-0.	-0.	0.
13	1947.	1.	0.	0.	0.
14	1947.	1.	1.	0.	0.
15	1947.	-5.	2.	0.	0.
16	1947.	-21.	1.	0.	-0.
17	1947.	-38.	-6.	-2.	-1.
18	1947.	-10.	-23.	-7.	-2.
19	1947.	172.	-39.	-12.	-0.
20	1947.	584.	-0.	-0.	9.

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.111
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 301

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.7565E-01	-0.2168E-01	-0.1305E-02
2	0.4691E-01	-0.2109E-01	0.4146E-02
3	0.4429E-02	-0.2018E-01	0.2688E-02
4	-0.1511E-01	-0.1904E-01	0.7931E-03
5	-0.1853E-01	-0.1783E-01	-0.4419E-04
6	-0.1682E-01	-0.1662E-01	-0.1768E-03
7	-0.1517E-01	-0.1542E-01	-0.9558E-04
8	-0.1452E-01	-0.1422E-01	-0.2258E-04
9	-0.1446E-01	-0.1303E-01	0.4920E-05
10	-0.1454E-01	-0.1184E-01	0.7036E-05
11	-0.1460E-01	-0.1065E-01	0.2524E-05
12	-0.1461E-01	-0.9463E-02	-0.1163E-05
13	-0.1458E-01	-0.8272E-02	-0.1637E-05
14	-0.1459E-01	-0.7081E-02	0.4686E-05
15	-0.1474E-01	-0.5890E-02	0.2236E-04
16	-0.1514E-01	-0.4697E-02	0.4342E-04
17	-0.1558E-01	-0.3501E-02	0.1624E-04
18	-0.1487E-01	-0.2304E-02	-0.1782E-03
19	-0.1032E-01	-0.1125E-02	-0.6371E-03
20	-0.9239E-07	-0.4249E-07	-0.1034E-02

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.112
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 301

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	2832.	5247.	14304.	8688.	-8640.	1805.
2	2832.	3576.	3142.	3669.	2522.	3484.
3	2832.	1107.	834.	508.	4830.	1707.
4	2832.	-28.	1597.	-399.	4067.	342.
5	2832.	-227.	2485.	-331.	3179.	-123.
6	2832.	-128.	2863.	-119.	2801.	-137.
7	2832.	-32.	2916.	-7.	2748.	-57.
8	2832.	5.	2876.	18.	2788.	-8.
9	2832.	9.	2842.	12.	2822.	6.
10	2832.	4.	2829.	3.	2835.	5.
11	2832.	1.	2828.	-0.	2836.	2.
12	2832.	1.	2830.	0.	2834.	1.
13	2832.	2.	2834.	2.	2830.	1.
14	2832.	1.	2842.	5.	2822.	-2.
15	2832.	-7.	2853.	-1.	2811.	-13.
16	2832.	-30.	2842.	-27.	2822.	-33.
17	2832.	-56.	2755.	-79.	2910.	-33.
18	2832.	-14.	2540.	-102.	3124.	73.
19	2832.	250.	2336.	101.	3328.	399.
20	2832.	850.	2832.	850.	2832.	850.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.113

BODY NO. 301 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	5269.		14304.		10445.	
2	3579.		3669.		3484.	
3	2832.		834.		4830.	
4	2861.		1996.		4067.	
5	3059.		2817.		3302.	
6	2960.		2982.		2939.	
7	2864.		2923.		2806.	
8	2832.		2876.		2796.	
9	2832.		2842.		2822.	
10	2832.		2829.		2835.	
11	2832.		2828.		2836.	
12	2832.		2830.		2834.	
13	2832.		2834.		2830.	
14	2832.		2842.		2823.	
15	2839.		2854.		2825.	
16	2862.		2869.		2855.	
17	2888.		2834.		2942.	
18	2846.		2642.		3124.	
19	2832.		2336.		3328.	
20	2832.		2832.		2832.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 402

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11665.	208.	-4528.	-1295.	579.
2	11691.	457.	-3887.	-1094.	526.
3	11716.	739.	-3307.	-912.	473.
4	11741.	1051.	-2788.	-749.	420.
5	11765.	1388.	-2330.	-606.	368.
6	11788.	1745.	-1932.	-482.	316.
7	11811.	2121.	-1594.	-377.	264.
8	11833.	2511.	-1317.	-290.	213.
9	11854.	2915.	-1098.	-221.	163.
10	11875.	3328.	-938.	-171.	112.
11	11895.	3751.	-837.	-138.	63.
12	11914.	4183.	-794.	-123.	14.
13	11932.	4623.	-807.	-125.	-35.
14	11949.	5072.	-878.	-144.	-83.
15	11965.	5529.	-1005.	-179.	-131.
16	11980.	5997.	-1188.	-231.	-178.
17	11995.	6476.	-1426.	-299.	-224.
18	12008.	6969.	-1719.	-383.	-270.
19	12020.	7479.	-2066.	-482.	-315.
20	12031.	8008.	-2466.	-597.	-360.

II.6.2.115

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 402

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	-0.1053E 00	-0.2131E-01	-0.4639E-02
2	-0.9954E-01	-0.2083E-01	-0.5292E-02
3	-0.9304E-01	-0.2036E-01	-0.5851E-02
4	-0.8592E-01	-0.1990E-01	-0.6326E-02
5	-0.7830E-01	-0.1945E-01	-0.6726E-02
6	-0.7024E-01	-0.1902E-01	-0.7060E-02
7	-0.6182E-01	-0.1860E-01	-0.7337E-02
8	-0.5310E-01	-0.1819E-01	-0.7567E-02
9	-0.4413E-01	-0.1780E-01	-0.7758E-02
10	-0.3495E-01	-0.1743E-01	-0.7921E-02
11	-0.2559E-01	-0.1707E-01	-0.8063E-02
12	-0.1607E-01	-0.1672E-01	-0.8194E-02
13	-0.6395E-02	-0.1640E-01	-0.8323E-02
14	0.3438E-02	-0.1609E-01	-0.8459E-02
15	0.1344E-01	-0.1580E-01	-0.8610E-02
16	0.2364E-01	-0.1552E-01	-0.8785E-02
17	0.3406E-01	-0.1527E-01	-0.8993E-02
18	0.4475E-01	-0.1503E-01	-0.9243E-02
19	0.5577E-01	-0.1481E-01	-0.9542E-02
20	0.6717E-01	-0.1461E-01	-0.9899E-02

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.116
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 402

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8115.	145.	-5032.	-3616.	21262.	3906.
2	8133.	318.	-3153.	-2858.	19418.	3494.
3	8150.	514.	-1451.	-2134.	17751.	3162.
4	8167.	731.	73.	-1445.	16262.	2907.
5	8184.	965.	1420.	-795.	14948.	2725.
6	8200.	1214.	2591.	-185.	13810.	2614.
7	8216.	1475.	3587.	382.	12846.	2569.
8	8232.	1747.	4409.	906.	12054.	2588.
9	8247.	2027.	5058.	1385.	11435.	2670.
10	8261.	2315.	5536.	1820.	10985.	2811.
11	8275.	2610.	5844.	2209.	10705.	3010.
12	8288.	2910.	5984.	2554.	10592.	3266.
13	8300.	3216.	5956.	2854.	10645.	3578.
14	8312.	3528.	5763.	3111.	10862.	3945.
15	8324.	3846.	5405.	3326.	11242.	4366.
16	8334.	4172.	4884.	3501.	11784.	4843.
17	8344.	4505.	4203.	3636.	12485.	5374.
18	8353.	4848.	3362.	3736.	13345.	5960.
19	8362.	5203.	2363.	3802.	14360.	6603.
20	8369.	5571.	1209.	3838.	15530.	7304.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 402 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	8204.		5032.		21262.	*
2	8206.		3153.		19418.	*
3	8210.		2134.		17751.	
4	8214.		1518.		16262.	
5	8220.		2215.		14948.	
6	8227.		2776.		13810.	
7	8235.		3587.		12846.	
8	8244.		4409.		12054.	
9	8254.		5058.		11435.	
10	8264.		5536.		10985.	
11	8276.		5844.		10705.	
12	8288.		5984.		10592.	
13	8301.		5956.		10645.	
14	8314.		5763.		10862.	
15	8328.		5405.		11242.	
16	8342.		4884.		11784.	
17	8357.		4203.		12485.	
18	8372.		3736.		13345.	
19	8388.		3802.		14360.	
20	8403.		3838.		15530.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 403

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11220.	-519.	-3694.	-1134.	429.
2	11242.	-652.	-3264.	-999.	380.
3	11264.	-759.	-2885.	-880.	332.
4	11287.	-842.	-2558.	-778.	283.
5	11309.	-904.	-2284.	-691.	234.
6	11332.	-947.	-2062.	-621.	185.
7	11356.	-973.	-1892.	-566.	135.
8	11379.	-984.	-1775.	-528.	86.
9	11403.	-980.	-1712.	-506.	37.
10	11427.	-962.	-1701.	-500.	-13.
11	11451.	-929.	-1744.	-510.	-62.
12	11475.	-882.	-1839.	-535.	-112.
13	11499.	-820.	-1989.	-576.	-161.
14	11524.	-741.	-2191.	-633.	-210.
15	11548.	-644.	-2447.	-706.	-260.
16	11572.	-526.	-2756.	-794.	-309.
17	11596.	-385.	-3119.	-897.	-358.
18	11620.	-218.	-3535.	-1016.	-407.
19	11644.	-21.	-4004.	-1150.	-456.
20	11668.	210.	-4527.	-1299.	-504.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.119

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 403

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	-0.1235E 00	-0.4033E-01	0.2145E-02
2	-0.1256E 00	-0.3984E-01	0.1653E-02
3	-0.1272E 00	-0.3935E-01	0.1219E-02
4	-0.1284E 00	-0.3886E-01	0.8346E-03
5	-0.1292E 00	-0.3836E-01	0.4926E-03
6	-0.1296E 00	-0.3786E-01	0.1855E-03
7	-0.1297E 00	-0.3736E-01	-0.9397E-04
8	-0.1295E 00	-0.3686E-01	-0.3533E-03
9	-0.1290E 00	-0.3636E-01	-0.6001E-03
10	-0.1283E 00	-0.3585E-01	-0.8417E-03
11	-0.1273E 00	-0.3535E-01	-0.1086E-02
12	-0.1261E 00	-0.3485E-01	-0.1340E-02
13	-0.1245E 00	-0.3436E-01	-0.1611E-02
14	-0.1227E 00	-0.3386E-01	-0.1908E-02
15	-0.1205E 00	-0.3337E-01	-0.2237E-02
16	-0.1180E 00	-0.3288E-01	-0.2606E-02
17	-0.1150E 00	-0.3240E-01	-0.3024E-02
18	-0.1115E 00	-0.3192E-01	-0.3496E-02
19	-0.1075E 00	-0.3145E-01	-0.4032E-02
20	-0.1029E 00	-0.3098E-01	-0.4639E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 403

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	7806.	-361.	-2920.	-3654.	18531.	2932.
2	7821.	-453.	-1656.	-3355.	17297.	2448.
3	7836.	-528.	-541.	-3084.	16213.	2028.
4	7852.	-585.	424.	-2843.	15280.	1672.
5	7867.	-629.	1237.	-2635.	14498.	1378.
6	7883.	-659.	1898.	-2461.	13869.	1144.
7	7900.	-677.	2406.	-2322.	13393.	968.
8	7916.	-684.	2761.	-2218.	13071.	849.
9	7932.	-682.	2963.	-2151.	12902.	788.
10	7949.	-669.	3010.	-2120.	12888.	782.
11	7966.	-646.	2903.	-2126.	13028.	833.
12	7983.	-614.	2642.	-2167.	13323.	940.
13	7999.	-570.	2225.	-2244.	13773.	1103.
14	8016.	-516.	1654.	-2355.	14379.	1324.
15	8033.	-448.	928.	-2498.	15139.	1602.
16	8050.	-366.	46.	-2671.	16054.	1940.
17	8067.	-268.	-990.	-2874.	17124.	2338.
18	8084.	-152.	-2181.	-3102.	18349.	2799.
19	8100.	-15.	-3527.	-3353.	19727.	3324.
20	8117.	146.	-5027.	-3625.	21261.	3917.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 403 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	8192.		3654.		18531.	
2	8294.		3355.		17297.	
3	8379.		3084.		16213.	
4	8448.		3267.		15280.	
5	8504.		3872.		14498.	
6	8547.		4359.		13869.	
7	8579.		4728.		13393.	
8	8601.		4979.		13071.	
9	8614.		5114.		12902.	
10	8618.		5130.		12888.	
11	8613.		5029.		13028.	
12	8598.		4809.		13323.	
13	8573.		4470.		13773.	
14	8538.		4009.		14379.	
15	8490.		3426.		15139.	
16	8429.		2718.		16054.	
17	8352.		2874.		17124.	
18	8258.		3102.		18349.	
19	8156.		3527.		19727.	*
20	8185.		5027.		21261.	*

II.6.2.122

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 404

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	10921.	4979.	-1569.	-528.	292.
2	10931.	4626.	-1277.	-438.	254.
3	10941.	4284.	-1026.	-361.	215.
4	10952.	3950.	-817.	-298.	176.
5	10964.	3624.	-650.	-247.	136.
6	10976.	3302.	-527.	-209.	95.
7	10989.	2985.	-447.	-185.	54.
8	11003.	2671.	-412.	-174.	12.
9	11017.	2360.	-422.	-176.	-30.
10	11032.	2052.	-478.	-192.	-73.
11	11048.	1748.	-581.	-223.	-116.
12	11064.	1449.	-730.	-267.	-160.
13	11081.	1155.	-928.	-325.	-205.
14	11099.	870.	-1173.	-397.	-250.
15	11117.	594.	-1468.	-483.	-295.
16	11136.	332.	-1812.	-584.	-341.
17	11155.	85.	-2206.	-699.	-387.
18	11175.	-142.	-2651.	-829.	-434.
19	11196.	-345.	-3147.	-973.	-482.
20	11217.	-520.	-3694.	-1132.	-529.

II.6.2.123

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 404

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	-0.3135E-01	-0.5847E-01	0.5407E-02
2	-0.3715E-01	-0.5816E-01	0.5209E-02
3	-0.4276E-01	-0.5784E-01	0.5048E-02
4	-0.4821E-01	-0.5751E-01	0.4921E-02
5	-0.5353E-01	-0.5716E-01	0.4820E-02
6	-0.5877E-01	-0.5680E-01	0.4739E-02
7	-0.6392E-01	-0.5644E-01	0.4673E-02
8	-0.6900E-01	-0.5606E-01	0.4615E-02
9	-0.7403E-01	-0.5567E-01	0.4559E-02
10	-0.7899E-01	-0.5527E-01	0.4498E-02
11	-0.8388E-01	-0.5485E-01	0.4426E-02
12	-0.8868E-01	-0.5443E-01	0.4335E-02
13	-0.9337E-01	-0.5400E-01	0.4221E-02
14	-0.9792E-01	-0.5355E-01	0.4075E-02
15	-0.1023E 00	-0.5310E-01	0.3890E-02
16	-0.1064E 00	-0.5264E-01	0.3660E-02
17	-0.1103E 00	-0.5217E-01	0.3378E-02
18	-0.1139E 00	-0.5168E-01	0.3036E-02
19	-0.1170E 00	-0.5120E-01	0.2628E-02
20	-0.1196E 00	-0.5070E-01	0.2145E-02

II.6.2.124

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 404

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	7597.	3464.	3041.	1931.	12153.	4996.
2	7604.	3218.	3896.	1946.	11312.	4491.
3	7611.	2980.	4632.	1931.	10590.	4030.
4	7619.	2748.	5247.	1884.	9990.	3612.
5	7627.	2521.	5739.	1805.	9515.	3237.
6	7636.	2297.	6106.	1690.	9165.	2904.
7	7645.	2076.	6346.	1540.	8943.	2612.
8	7654.	1858.	6457.	1354.	8851.	2362.
9	7664.	1642.	6437.	1130.	8891.	2153.
10	7675.	1427.	6285.	869.	9064.	1986.
11	7685.	1216.	5999.	570.	9372.	1862.
12	7697.	1008.	5576.	234.	9817.	1782.
13	7709.	804.	5015.	-139.	10402.	1746.
14	7721.	605.	4314.	-547.	11127.	1757.
15	7734.	413.	3472.	-990.	11995.	1817.
16	7747.	231.	2486.	-1465.	13007.	1927.
17	7760.	59.	1356.	-1971.	14165.	2090.
18	7774.	-99.	78.	-2506.	15471.	2309.
19	7789.	-240.	-1348.	-3066.	16925.	2587.
20	7803.	-361.	-2924.	-3649.	18530.	2927.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 404   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	7622.		3041.		12153.	
2	7622.		3896.		11312.	
3	7624.		4632.		10590.	
4	7628.		5247.		9990.	
5	7632.		5739.		9515.	
6	7638.		6106.		9165.	
7	7645.		6346.		8943.	
8	7654.		6457.		8851.	
9	7664.		6437.		8891.	
10	7676.		6285.		9064.	
11	7689.		5999.		9372.	
12	7704.		5576.		9817.	
13	7720.		5154.		10402.	
14	7738.		4862.		11127.	
15	7758.		4462.		11995.	
16	7779.		3951.		13007.	
17	7802.		3327.		14165.	
18	7899.		2584.		15471.	
19	8061.		3066.		16925.	
20	8204.		3649.		18530.	

II.6.2.126

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 405

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	10821.	9567.	4534.	1372.	-22.
2	10823.	9634.	4500.	1356.	-50.
3	10825.	9657.	4435.	1331.	-78.
4	10826.	9635.	4340.	1297.	-106.
5	10828.	9571.	4216.	1254.	-134.
6	10830.	9465.	4060.	1202.	-162.
7	10833.	9318.	3875.	1141.	-191.
8	10836.	9133.	3658.	1071.	-219.
9	10839.	8911.	3410.	991.	-249.
10	10842.	8655.	3130.	903.	-278.
11	10846.	8367.	2818.	805.	-308.
12	10850.	8051.	2472.	698.	-339.
13	10855.	7710.	2093.	581.	-370.
14	10861.	7347.	1680.	454.	-402.
15	10867.	6968.	1231.	317.	-435.
16	10874.	6575.	746.	170.	-468.
17	10881.	6174.	225.	13.	-502.
18	10890.	5770.	-334.	-155.	-537.
19	10899.	5368.	-932.	-333.	-573.
20	10908.	4975.	-1569.	-523.	-609.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 405

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.4519E-01	-0.6442E-01	-0.1304E-02
2	0.4614E-01	-0.6429E-01	-0.6647E-03
3	0.4640E-01	-0.6416E-01	-0.3130E-04
4	0.4598E-01	-0.6403E-01	0.5909E-03
5	0.4491E-01	-0.6389E-01	0.1198E-02
6	0.4319E-01	-0.6375E-01	0.1785E-02
7	0.4085E-01	-0.6361E-01	0.2349E-02
8	0.3792E-01	-0.6347E-01	0.2884E-02
9	0.3443E-01	-0.6331E-01	0.3387E-02
10	0.3043E-01	-0.6315E-01	0.3852E-02
11	0.2594E-01	-0.6297E-01	0.4275E-02
12	0.2102E-01	-0.6279E-01	0.4653E-02
13	0.1573E-01	-0.6259E-01	0.4979E-02
14	0.1011E-01	-0.6239E-01	0.5249E-02
15	0.4237E-02	-0.6217E-01	0.5458E-02
16	-0.1828E-02	-0.6193E-01	0.5601E-02
17	-0.8008E-02	-0.6168E-01	0.5673E-02
18	-0.1422E-01	-0.6142E-01	0.5668E-02
19	-0.2039E-01	-0.6114E-01	0.5581E-02
20	-0.2642E-01	-0.6085E-01	0.5407E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 405

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	7528.	6655.	20694.	10639.	-5638.	2671.
2	7529.	6702.	20594.	10639.	-5537.	2765.
3	7530.	6718.	20408.	10582.	-5348.	2853.
4	7531.	6703.	20134.	10468.	-5072.	2938.
5	7533.	6658.	19773.	10298.	-4708.	3018.
6	7534.	6584.	19324.	10073.	-4256.	3095.
7	7536.	6482.	18786.	9794.	-3715.	3170.
8	7538.	6353.	18159.	9462.	-3084.	3244.
9	7540.	6199.	17441.	9078.	-2361.	3320.
10	7542.	6021.	16630.	8643.	-1546.	3399.
11	7545.	5821.	15727.	8159.	-637.	3483.
12	7548.	5601.	14727.	7627.	369.	3574.
13	7551.	5363.	13630.	7050.	1473.	3677.
14	7555.	5111.	12433.	6430.	2678.	3792.
15	7560.	4847.	11134.	5769.	3985.	3925.
16	7564.	4574.	9732.	5069.	5397.	4079.
17	7570.	4295.	8223.	4333.	6917.	4257.
18	7575.	4014.	6605.	3564.	8546.	4463.
19	7582.	3734.	4876.	2767.	10287.	4702.
20	7588.	3461.	3034.	1943.	12143.	4979.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 405 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	7528.		20694.	*	8310.	
2	7530.		20594.	*	8301.	
3	7532.		20408.	*	8201.	
4	7535.		20134.	*	8009.	
5	7538.		19773.	*	7726.	
6	7542.		19324.	*	7351.	
7	7546.		18786.		6885.	
8	7552.		18159.		6328.	
9	7558.		17441.		5681.	
10	7565.		16630.		4945.	
11	7572.		15727.		4119.	
12	7581.		14727.		3574.	
13	7591.		13630.		3677.	
14	7602.		12433.		3792.	
15	7614.		11134.		3985.	
16	7627.		9732.		5397.	
17	7642.		8223.		6917.	
18	7658.		6605.		8546.	
19	7675.		4876.		10287.	
20	7694.		3034.		12143.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 406

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	12386.	4712.	-725.	-164.	589.
2	12392.	5091.	-259.	-23.	566.
3	12398.	5472.	189.	111.	544.
4	12403.	5853.	620.	241.	522.
5	12408.	6230.	1033.	364.	501.
6	12413.	6602.	1430.	482.	480.
7	12418.	6965.	1811.	595.	460.
8	12422.	7319.	2176.	703.	440.
9	12426.	7660.	2526.	806.	421.
10	12430.	7986.	2860.	905.	402.
11	12433.	8296.	3180.	998.	384.
12	12437.	8588.	3485.	1087.	366.
13	12440.	8859.	3776.	1171.	349.
14	12442.	9109.	4053.	1251.	331.
15	12445.	9335.	4317.	1327.	315.
16	12447.	9535.	4567.	1398.	298.
17	12450.	9709.	4804.	1465.	282.
18	12452.	9855.	5029.	1528.	265.
19	12454.	9972.	5240.	1587.	249.
20	12456.	10058.	5439.	1642.	234.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

I.6.2.131

BODY NO. 406

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	-0.2799E-01	-0.6446E-01	-0.6942E-02
2	-0.2244E-01	-0.6420E-01	-0.6996E-02
3	-0.1687E-01	-0.6396E-01	-0.7001E-02
4	-0.1131E-01	-0.6372E-01	-0.6960E-02
5	-0.5798E-02	-0.6350E-01	-0.6874E-02
6	-0.3776E-03	-0.6328E-01	-0.6744E-02
7	0.4921E-02	-0.6308E-01	-0.6574E-02
8	0.1007E-01	-0.6288E-01	-0.6363E-02
9	0.1503E-01	-0.6269E-01	-0.6114E-02
10	0.1977E-01	-0.6251E-01	-0.5829E-02
11	0.2427E-01	-0.6234E-01	-0.5509E-02
12	0.2850E-01	-0.6218E-01	-0.5156E-02
13	0.3243E-01	-0.6202E-01	-0.4771E-02
14	0.3603E-01	-0.6187E-01	-0.4355E-02
15	0.3929E-01	-0.6173E-01	-0.3911E-02
16	0.4218E-01	-0.6159E-01	-0.3439E-02
17	0.4468E-01	-0.6146E-01	-0.2941E-02
18	0.4676E-01	-0.6133E-01	-0.2418E-02
19	0.4841E-01	-0.6121E-01	-0.1872E-02
20	0.4961E-01	-0.6109E-01	-0.1304E-02

II.C.2.132

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 406

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8616.	3278.	6510.	2803.	10723.	3753.
2	8621.	3542.	7867.	3474.	9374.	3609.
3	8625.	3807.	9173.	4131.	8076.	3483.
4	8628.	4072.	10427.	4770.	6830.	3373.
5	8632.	4334.	11632.	5391.	5632.	3277.
6	8635.	4593.	12788.	5993.	4482.	3192.
7	8639.	4846.	13897.	6574.	3380.	3117.
8	8641.	5091.	14960.	7134.	2323.	3049.
9	8644.	5329.	15978.	7670.	1311.	2987.
10	8647.	5556.	16951.	8182.	342.	2929.
11	8649.	5771.	17882.	8669.	-583.	2873.
12	8652.	5974.	18770.	9130.	-1467.	2818.
13	8654.	6163.	19618.	9564.	-2310.	2762.
14	8656.	6337.	20425.	9970.	-3113.	2704.
15	8657.	6494.	21192.	10346.	-3877.	2641.
16	8659.	6633.	21921.	10693.	-4602.	2574.
17	8661.	6754.	22611.	11009.	-5290.	2500.
18	8662.	6856.	23263.	11294.	-5939.	2418.
19	8664.	6937.	23879.	11546.	-6551.	2328.
20	8665.	6997.	24457.	11765.	-7127.	2228.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 406   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	8704.		6510.		10723.	
2	8701.		7867.		9374.	
3	8699.		9173.		8076.	
4	8697.		10427.		6830.	
5	8695.		11632.		5632.	
6	8693.		12788.		4482.	
7	8692.		13897.		3380.	
8	8690.		14960.		3049.	
9	8689.		15978.		2987.	
10	8688.		16951.		2929.	
11	8686.		17882.		3457.	
12	8685.		18770.		4285.	
13	8684.		19618.	*	5072.	
14	8683.		20425.	*	5817.	
15	8682.		21192.	*	6518.	
16	8681.		21921.	*	7176.	
17	8681.		22611.	*	7789.	
18	8680.		23263.	*	8357.	
19	8679.		23879.	*	8879.	
20	8679.		24457.	*	9355.	

II.6.2.134

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 407

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	12234.	-2047.	-2208.	-627.	371.
2	12244.	-1748.	-1922.	-540.	339.
3	12254.	-1437.	-1662.	-461.	308.
4	12265.	-1116.	-1426.	-389.	277.
5	12275.	-785.	-1215.	-324.	247.
6	12284.	-447.	-1028.	-267.	217.
7	12294.	-102.	-865.	-217.	188.
8	12304.	248.	-725.	-175.	159.
9	12313.	603.	-608.	-139.	131.
10	12322.	962.	-514.	-110.	103.
11	12331.	1325.	-442.	-88.	76.
12	12339.	1691.	-392.	-72.	49.
13	12348.	2059.	-363.	-63.	23.
14	12356.	2430.	-355.	-61.	-3.
15	12364.	2803.	-368.	-64.	-28.
16	12372.	3180.	-401.	-73.	-53.
17	12379.	3558.	-453.	-89.	-77.
18	12386.	3941.	-525.	-110.	-101.
19	12393.	4326.	-616.	-136.	-124.
20	12400.	4716.	-726.	-169.	-146.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 407

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	-0.1198E 00	-0.7258E-01	-0.5283E-02
2	-0.1155E 00	-0.7216E-01	-0.5504E-02
3	-0.1111E 00	-0.7174E-01	-0.5696E-02
4	-0.1065E 00	-0.7133E-01	-0.5861E-02
5	-0.1018E 00	-0.7093E-01	-0.6003E-02
6	-0.9704E-01	-0.7053E-01	-0.6124E-02
7	-0.9215E-01	-0.7015E-01	-0.6226E-02
8	-0.8718E-01	-0.6977E-01	-0.6312E-02
9	-0.8215E-01	-0.6941E-01	-0.6384E-02
10	-0.7706E-01	-0.6905E-01	-0.6445E-02
11	-0.7193E-01	-0.6870E-01	-0.6497E-02
12	-0.6676E-01	-0.6836E-01	-0.6543E-02
13	-0.6156E-01	-0.6803E-01	-0.6584E-02
14	-0.5632E-01	-0.6771E-01	-0.6624E-02
15	-0.5105E-01	-0.6740E-01	-0.6664E-02
16	-0.4575E-01	-0.6710E-01	-0.6706E-02
17	-0.4041E-01	-0.6681E-01	-0.6753E-02
18	-0.3503E-01	-0.6653E-01	-0.6807E-02
19	-0.2960E-01	-0.6626E-01	-0.6869E-02
20	-0.2412E-01	-0.6600E-01	-0.6942E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 407

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8510.	-1424.	2100.	-3245.	14921.	398.
2	8518.	-1216.	2936.	-2784.	14099.	352.
3	8525.	-1000.	3699.	-2337.	13350.	338.
4	8532.	-776.	4391.	-1904.	12673.	352.
5	8539.	-546.	5011.	-1487.	12067.	395.
6	8546.	-311.	5561.	-1086.	11531.	465.
7	8552.	-71.	6041.	-702.	11064.	560.
8	8559.	173.	6454.	-334.	10664.	680.
9	8565.	420.	6800.	16.	10331.	823.
10	8572.	669.	7080.	350.	10064.	989.
11	8578.	922.	7295.	666.	9861.	1177.
12	8584.	1176.	7447.	966.	9721.	1386.
13	8590.	1432.	7537.	1248.	9643.	1616.
14	8595.	1690.	7565.	1515.	9626.	1866.
15	8601.	1950.	7533.	1765.	9668.	2136.
16	8606.	2212.	7443.	1999.	9769.	2425.
17	8611.	2475.	7295.	2218.	9928.	2733.
18	8616.	2741.	7091.	2423.	10142.	3060.
19	8621.	3010.	6832.	2613.	10411.	3406.
20	8626.	3281.	6519.	2791.	10733.	3770.

II.6.2.137

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 407 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	9952.		5345.		14921.	
2	9748.		5720.		14099.	
3	9537.		6036.		13350.	
4	9318.		6295.		12673.	
5	9093.		6498.		12067.	
6	8863.		6647.		11531.	
7	8628.		6743.		11064.	
8	8565.		6788.		10664.	
9	8570.		6800.		10331.	
10	8574.		7080.		10064.	
11	8579.		7295.		9861.	
12	8584.		7447.		9721.	
13	8590.		7537.		9643.	
14	8595.		7565.		9626.	
15	8601.		7533.		9668.	
16	8607.		7443.		9769.	
17	8613.		7295.		9928.	
18	8619.		7091.		10142.	
19	8625.		6832.		10411.	
20	8631.		6519.		10733.	

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 408

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	12063.	-5598.	-1945.	-568.	259.
2	12072.	-5468.	-1781.	-518.	229.
3	12082.	-5330.	-1637.	-474.	198.
4	12091.	-5185.	-1514.	-436.	168.
5	12100.	-5033.	-1411.	-404.	138.
6	12110.	-4875.	-1328.	-379.	109.
7	12119.	-4711.	-1265.	-359.	79.
8	12128.	-4541.	-1223.	-346.	50.
9	12138.	-4366.	-1199.	-338.	20.
10	12147.	-4185.	-1196.	-336.	-9.
11	12156.	-4000.	-1212.	-340.	-37.
12	12165.	-3808.	-1247.	-350.	-66.
13	12174.	-3611.	-1302.	-366.	-94.
14	12184.	-3409.	-1375.	-387.	-122.
15	12193.	-3200.	-1468.	-414.	-150.
16	12202.	-2984.	-1579.	-447.	-177.
17	12211.	-2762.	-1709.	-485.	-205.
18	12219.	-2532.	-1857.	-528.	-232.
19	12228.	-2293.	-2024.	-577.	-258.
20	12237.	-2045.	-2208.	-631.	-285.

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HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 408

STATION		DISPLACEMENTS	
	NORMAL	TANGENTIAL	ROTATION
1	-0.1648E 00	-0.8651E-01	-0.2743E-02
2	-0.1630E 00	-0.8608E-01	-0.2909E-02
3	-0.1611E 00	-0.8565E-01	-0.3062E-02
4	-0.1591E 00	-0.8522E-01	-0.3203E-02
5	-0.1570E 00	-0.8479E-01	-0.3333E-02
6	-0.1548E 00	-0.8437E-01	-0.3456E-02
7	-0.1525E 00	-0.8396E-01	-0.3572E-02
8	-0.1502E 00	-0.8354E-01	-0.3683E-02
9	-0.1477E 00	-0.8313E-01	-0.3791E-02
10	-0.1452E 00	-0.8272E-01	-0.3899E-02
11	-0.1427E 00	-0.8232E-01	-0.4006E-02
12	-0.1400E 00	-0.8192E-01	-0.4116E-02
13	-0.1373E 00	-0.8153E-01	-0.4230E-02
14	-0.1345E 00	-0.8114E-01	-0.4350E-02
15	-0.1316E 00	-0.8075E-01	-0.4477E-02
16	-0.1287E 00	-0.8037E-01	-0.4614E-02
17	-0.1256E 00	-0.7999E-01	-0.4761E-02
18	-0.1224E 00	-0.7962E-01	-0.4920E-02
19	-0.1191E 00	-0.7926E-01	-0.5094E-02
20	-0.1157E 00	-0.7889E-01	-0.5283E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 408

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTRENE FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8391.	-3894.	2743.	-5544.	14040.	-2244.
2	8398.	-3804.	3226.	-5308.	13570.	-2300.
3	8405.	-3708.	3650.	-5084.	13159.	-2332.
4	8411.	-3607.	4014.	-4873.	12808.	-2341.
5	8418.	-3501.	4320.	-4675.	12515.	-2327.
6	8424.	-3391.	4567.	-4491.	12281.	-2291.
7	8431.	-3277.	4756.	-4320.	12105.	-2234.
8	8437.	-3159.	4887.	-4162.	11987.	-2155.
9	8444.	-3037.	4961.	-4018.	11926.	-2056.
10	8450.	-2912.	4978.	-3888.	11922.	-1935.
11	8456.	-2782.	4938.	-3770.	11975.	-1794.
12	8463.	-2649.	4841.	-3666.	12084.	-1632.
13	8469.	-2512.	4689.	-3574.	12249.	-1450.
14	8476.	-2371.	4482.	-3495.	12469.	-1247.
15	8482.	-2226.	4220.	-3428.	12744.	-1024.
16	8488.	-2076.	3903.	-3373.	13073.	-779.
17	8494.	-1921.	3532.	-3328.	13457.	-514.
18	8500.	-1761.	3108.	-3294.	13893.	-228.
19	8507.	-1595.	2631.	-3270.	14382.	80.
20	8513.	-1423.	2101.	-3255.	14924.	409.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 408 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	12294.		8287.		16284.	
2	12209.		8534.		15870.	
3	12117.		8734.		15491.	
4	12022.		8888.		15148.	
5	11921.		8996.		14842.	
6	11817.		9058.		14572.	
7	11708.		9076.		14339.	
8	11596.		9050.		14142.	
9	11481.		8980.		13982.	
10	11362.		8866.		13858.	
11	11239.		8708.		13769.	
12	11113.		8508.		13717.	
13	10983.		8264.		13699.	
14	10849.		7977.		13716.	
15	10711.		7648.		13768.	
16	10568.		7276.		13853.	
17	10421.		6860.		13971.	
18	10268.		6402.		14121.	
19	10110.		5901.		14382.	
20	9946.		5356.		14924.	

II.6.2.142

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 409

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11895.	-7098.	-1579.	-470.	273.
2	11903.	-7060.	-1405.	-417.	241.
3	11912.	-7017.	-1254.	-371.	209.
4	11920.	-6968.	-1123.	-331.	177.
5	11928.	-6914.	-1015.	-298.	145.
6	11937.	-6855.	-928.	-272.	113.
7	11946.	-6792.	-862.	-252.	82.
8	11954.	-6725.	-818.	-238.	50.
9	11963.	-6655.	-795.	-231.	18.
10	11972.	-6581.	-794.	-230.	-13.
11	11980.	-6504.	-814.	-236.	-45.
12	11989.	-6422.	-855.	-248.	-76.
13	11998.	-6337.	-918.	-266.	-108.
14	12007.	-6248.	-1001.	-291.	-139.
15	12016.	-6154.	-1106.	-322.	-170.
16	12025.	-6056.	-1232.	-359.	-201.
17	12034.	-5952.	-1378.	-402.	-232.
18	12043.	-5841.	-1546.	-452.	-262.
19	12052.	-5724.	-1734.	-507.	-293.
20	12061.	-5599.	-1943.	-569.	-323.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 409

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	-0.1804E 00	-0.1029E 00	-0.8410E-03
2	-0.1799E 00	-0.1025E 00	-0.9738E-03
3	-0.1794E 00	-0.1020E 00	-0.1092E-02
4	-0.1787E 00	-0.1015E 00	-0.1198E-02
5	-0.1780E 00	-0.1011E 00	-0.1293E-02
6	-0.1772E 00	-0.1006E 00	-0.1380E-02
7	-0.1764E 00	-0.1002E 00	-0.1460E-02
8	-0.1755E 00	-0.9971E-01	-0.1534E-02
9	-0.1746E 00	-0.9926E-01	-0.1606E-02
10	-0.1736E 00	-0.9880E-01	-0.1677E-02
11	-0.1725E 00	-0.9835E-01	-0.1749E-02
12	-0.1715E 00	-0.9790E-01	-0.1823E-02
13	-0.1703E 00	-0.9745E-01	-0.1902E-02
14	-0.1691E 00	-0.9700E-01	-0.1988E-02
15	-0.1679E 00	-0.9656E-01	-0.2082E-02
16	-0.1666E 00	-0.9612E-01	-0.2186E-02
17	-0.1652E 00	-0.9567E-01	-0.2303E-02
18	-0.1637E 00	-0.9523E-01	-0.2433E-02
19	-0.1621E 00	-0.9480E-01	-0.2579E-02
20	-0.1605E 00	-0.9436E-01	-0.2743E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 409

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8275.	-4938.	3690.	-6301.	12859.	-3574.
2	8280.	-4912.	4200.	-6123.	12361.	-3701.
3	8286.	-4881.	4646.	-5958.	11926.	-3804.
4	8292.	-4847.	5030.	-5809.	11554.	-3885.
5	8298.	-4809.	5352.	-5676.	11244.	-3943.
6	8304.	-4769.	5611.	-5558.	10997.	-3980.
7	8310.	-4725.	5807.	-5456.	10813.	-3994.
8	8316.	-4678.	5941.	-5370.	10691.	-3987.
9	8322.	-4630.	6013.	-5300.	10631.	-3959.
10	8328.	-4578.	6023.	-5246.	10634.	-3910.
11	8334.	-4524.	5971.	-5209.	10698.	-3840.
12	8340.	-4468.	5857.	-5187.	10824.	-3748.
13	8347.	-4409.	5682.	-5181.	11011.	-3636.
14	8353.	-4347.	5445.	-5191.	11260.	-3502.
15	8359.	-4281.	5147.	-5215.	11571.	-3348.
16	8365.	-4213.	4789.	-5254.	11942.	-3171.
17	8371.	-4140.	4369.	-5308.	12374.	-2973.
18	8378.	-4064.	3889.	-5375.	12867.	-2752.
19	8384.	-3982.	3348.	-5455.	13420.	-2508.
20	8390.	-3895.	2748.	-5548.	14033.	-2242.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 409 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	13222.		9992.		16432.	
2	13200.		10322.		16062.	
3	13173.		10605.		15730.	
4	13143.		10840.		15439.	
5	13110.		11027.		15188.	
6	13074.		11168.		14977.	
7	13036.		11263.		14807.	
8	12995.		11311.		14678.	
9	12952.		11313.		14590.	
10	12906.		11269.		14543.	
11	12859.		11179.		14537.	
12	12809.		11044.		14572.	
13	12757.		10863.		14647.	
14	12702.		10636.		14763.	
15	12644.		10363.		14918.	
16	12583.		10043.		15113.	
17	12519.		9677.		15347.	
18	12450.		9264.		15618.	
19	12377.		8804.		15928.	
20	12299.		8296.		16274.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 410

STATION	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
	STRESS RESULTANTS				
1	11760.	-6987.	-1676.	-506.	311.
2	11767.	-7032.	-1476.	-445.	279.
3	11773.	-7070.	-1299.	-392.	248.
4	11780.	-7102.	-1142.	-344.	216.
5	11786.	-7129.	-1008.	-304.	184.
6	11793.	-7151.	-894.	-269.	152.
7	11800.	-7170.	-803.	-242.	120.
8	11807.	-7184.	-733.	-220.	88.
9	11814.	-7196.	-684.	-205.	56.
10	11821.	-7204.	-658.	-197.	24.
11	11828.	-7210.	-652.	-195.	-8.
12	11835.	-7212.	-669.	-200.	-40.
13	11843.	-7212.	-707.	-211.	-72.
14	11850.	-7208.	-767.	-229.	-104.
15	11858.	-7201.	-849.	-253.	-136.
16	11865.	-7190.	-952.	-284.	-169.
17	11873.	-7175.	-1077.	-321.	-201.
18	11881.	-7155.	-1224.	-365.	-233.
19	11888.	-7129.	-1392.	-415.	-265.
20	11896.	-7097.	-1582.	-471.	-297.

II.6.2.147

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 410

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	-0.1728E 00	-0.1202E 00	0.8138E-03
2	-0.1735E 00	-0.1197E 00	0.6737E-03
3	-0.1740E 00	-0.1193E 00	0.5504E-03
4	-0.1745E 00	-0.1188E 00	0.4419E-03
5	-0.1749E 00	-0.1184E 00	0.3464E-03
6	-0.1753E 00	-0.1179E 00	0.2619E-03
7	-0.1756E 00	-0.1174E 00	0.1865E-03
8	-0.1759E 00	-0.1170E 00	0.1183E-03
9	-0.1761E 00	-0.1165E 00	0.5539E-04
10	-0.1762E 00	-0.1161E 00	-0.4187E-05
11	-0.1763E 00	-0.1156E 00	-0.6241E-04
12	-0.1764E 00	-0.1151E 00	-0.1211E-03
13	-0.1765E 00	-0.1147E 00	-0.1822E-03
14	-0.1765E 00	-0.1142E 00	-0.2477E-03
15	-0.1764E 00	-0.1138E 00	-0.3195E-03
16	-0.1763E 00	-0.1133E 00	-0.3997E-03
17	-0.1762E 00	-0.1128E 00	-0.4899E-03
18	-0.1760E 00	-0.1124E 00	-0.5922E-03
19	-0.1757E 00	-0.1119E 00	-0.7086E-03
20	-0.1753E 00	-0.1114E 00	-0.8411E-03

II-6-2-143

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 410

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8181.	-4861.	3316.	-6329.	13046.	-3392.
2	8185.	-4892.	3899.	-6185.	12472.	-3598.
3	8190.	-4918.	4419.	-6055.	11961.	-3781.
4	8195.	-4940.	4878.	-5940.	11511.	-3941.
5	8199.	-4959.	5274.	-5841.	11125.	-4078.
6	8204.	-4975.	5607.	-5757.	10801.	-4193.
7	8209.	-4988.	5878.	-5689.	10539.	-4286.
8	8213.	-4998.	6086.	-5637.	10341.	-4358.
9	8218.	-5006.	6231.	-5603.	10205.	-4409.
10	8223.	-5012.	6314.	-5584.	10132.	-4439.
11	8228.	-5016.	6334.	-5583.	10123.	-4448.
12	8233.	-5017.	6291.	-5599.	10176.	-4436.
13	8238.	-5017.	6185.	-5631.	10292.	-4403.
14	8244.	-5014.	6016.	-5680.	10471.	-4349.
15	8249.	-5010.	5784.	-5745.	10713.	-4274.
16	8254.	-5002.	5490.	-5827.	11019.	-4177.
17	8259.	-4991.	5132.	-5924.	11387.	-4059.
18	8265.	-4977.	4711.	-6036.	11818.	-3918.
19	8270.	-4960.	4228.	-6164.	12312.	-3755.
20	8276.	-4937.	3681.	-6306.	12870.	-3569.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 410 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	13055.		9645.		16439.	
2	13088.		10084.		16071.	
3	13116.		10475.		15742.	
4	13141.		10818.		15452.	
5	13163.		11114.		15203.	
6	13182.		11364.		14994.	
7	13198.		11567.		14826.	
8	13212.		11723.		14699.	
9	13225.		11834.		14614.	
10	13235.		11899.		14571.	
11	13244.		11917.		14571.	
12	13251.		11890.		14612.	
13	13256.		11816.		14695.	
14	13259.		11696.		14820.	
15	13261.		11530.		14987.	
16	13260.		11316.		15196.	
17	13256.		11056.		15446.	
18	13249.		10748.		15736.	
19	13239.		10392.		16067.	
20	13224.		9987.		16439.	

II.6.2.150

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 411

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11654.	-4723.	-2401.	-728.	379.
2	11658.	-4913.	-2116.	-642.	345.
3	11663.	-5090.	-1857.	-564.	312.
4	11667.	-5255.	-1625.	-494.	278.
5	11672.	-5410.	-1420.	-432.	243.
6	11677.	-5556.	-1242.	-379.	209.
7	11682.	-5695.	-1091.	-333.	174.
8	11688.	-5826.	-968.	-296.	139.
9	11693.	-5952.	-872.	-267.	104.
10	11698.	-6072.	-804.	-246.	69.
11	11704.	-6188.	-763.	-234.	34.
12	11710.	-6299.	-751.	-230.	-2.
13	11716.	-6405.	-767.	-235.	-38.
14	11722.	-6506.	-811.	-248.	-74.
15	11728.	-6603.	-884.	-269.	-110.
16	11734.	-6694.	-985.	-299.	-146.
17	11741.	-6778.	-1115.	-338.	-183.
18	11747.	-6856.	-1273.	-385.	-219.
19	11754.	-6926.	-1461.	-441.	-256.
20	11761.	-6987.	-1677.	-506.	-292.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 411

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	-0.1345E 00	-0.1383E 00	0.3180E-02
2	-0.1371E 00	-0.1379E 00	0.2946E-02
3	-0.1396E 00	-0.1374E 00	0.2740E-02
4	-0.1419E 00	-0.1369E 00	0.2559E-02
5	-0.1440E 00	-0.1365E 00	0.2401E-02
6	-0.1461E 00	-0.1360E 00	0.2263E-02
7	-0.1480E 00	-0.1355E 00	0.2143E-02
8	-0.1499E 00	-0.1350E 00	0.2036E-02
9	-0.1516E 00	-0.1345E 00	0.1941E-02
10	-0.1533E 00	-0.1340E 00	0.1854E-02
11	-0.1549E 00	-0.1335E 00	0.1773E-02
12	-0.1565E 00	-0.1330E 00	0.1695E-02
13	-0.1580E 00	-0.1325E 00	0.1617E-02
14	-0.1595E 00	-0.1320E 00	0.1535E-02
15	-0.1608E 00	-0.1315E 00	0.1447E-02
16	-0.1621E 00	-0.1310E 00	0.1351E-02
17	-0.1634E 00	-0.1305E 00	0.1242E-02
18	-0.1645E 00	-0.1299E 00	0.1118E-02
19	-0.1655E 00	-0.1294E 00	0.9765E-03
20	-0.1664E 00	-0.1289E 00	0.8137E-03

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.152
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 411

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8107.	-3286.	1137.	-5401.	15077.	-1170.
2	8110.	-3418.	1967.	-5283.	14253.	-1552.
3	8113.	-3541.	2721.	-5179.	13505.	-1902.
4	8116.	-3655.	3398.	-5091.	12835.	-2220.
5	8120.	-3763.	3997.	-5019.	12243.	-2508.
6	8123.	-3865.	4518.	-4965.	11729.	-2765.
7	8127.	-3961.	4959.	-4929.	11295.	-2994.
8	8130.	-4053.	5321.	-4912.	10940.	-3194.
9	8134.	-4141.	5603.	-4916.	10665.	-3366.
10	8138.	-4224.	5805.	-4939.	10471.	-3509.
11	8142.	-4305.	5926.	-4984.	10358.	-3625.
12	8146.	-4382.	5966.	-5050.	10326.	-3714.
13	8150.	-4456.	5923.	-5137.	10377.	-3774.
14	8154.	-4526.	5799.	-5245.	10509.	-3807.
15	8159.	-4593.	5593.	-5375.	10725.	-3811.
16	8163.	-4656.	5303.	-5526.	11023.	-3787.
17	8168.	-4715.	4931.	-5697.	11404.	-3734.
18	8172.	-4770.	4475.	-5888.	11869.	-3651.
19	8177.	-4818.	3935.	-6099.	12418.	-3537.
20	8182.	-4861.	3311.	-6329.	13052.	-3392.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.155

BODY NO. 411 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	11412.		6538.		16248.	
2	11544.		7250.		15805.	
3	11667.		7901.		15407.	
4	11782.		8489.		15055.	
5	11891.		9016.		14750.	
6	11994.		9482.		14495.	
7	12092.		9888.		14289.	
8	12186.		10233.		14134.	
9	12276.		10519.		14031.	
10	12363.		10744.		13980.	
11	12447.		10910.		13983.	
12	12528.		11015.		14040.	
13	12606.		11060.		14151.	
14	12681.		11045.		14316.	
15	12753.		10968.		14536.	
16	12822.		10829.		14810.	
17	12887.		10628.		15138.	
18	12948.		10363.		15520.	
19	13004.		10034.		15956.	
20	13054.		9640.		16444.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 412

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11608.	1113.	-2776.	-843.	286.
2	11610.	697.	-2560.	-778.	262.
3	11611.	297.	-2364.	-719.	237.
4	11613.	-88.	-2187.	-666.	211.
5	11615.	-459.	-2031.	-619.	185.
6	11617.	-818.	-1896.	-578.	159.
7	11619.	-1165.	-1782.	-543.	131.
8	11621.	-1500.	-1689.	-516.	104.
9	11624.	-1825.	-1619.	-494.	76.
10	11626.	-2140.	-1570.	-480.	47.
11	11629.	-2445.	-1545.	-472.	18.
12	11631.	-2740.	-1543.	-471.	-12.
13	11634.	-3025.	-1564.	-477.	-42.
14	11637.	-3301.	-1610.	-491.	-72.
15	11641.	-3567.	-1679.	-511.	-103.
16	11644.	-3822.	-1773.	-539.	-135.
17	11647.	-4066.	-1892.	-575.	-166.
18	11651.	-4298.	-2036.	-617.	-198.
19	11655.	-4517.	-2205.	-668.	-231.
20	11659.	-4722.	-2400.	-726.	-263.

II.6.2.155

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 412

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	-0.4769E-01	-0.1528E 00	0.6926E-02
2	-0.5327E-01	-0.1525E 00	0.6649E-02
3	-0.5864E-01	-0.1522E 00	0.6394E-02
4	-0.6382E-01	-0.1518E 00	0.6158E-02
5	-0.6881E-01	-0.1515E 00	0.5939E-02
6	-0.7364E-01	-0.1512E 00	0.5735E-02
7	-0.7832E-01	-0.1508E 00	0.5545E-02
8	-0.8285E-01	-0.1505E 00	0.5365E-02
9	-0.8724E-01	-0.1501E 00	0.5193E-02
10	-0.9150E-01	-0.1497E 00	0.5028E-02
11	-0.9563E-01	-0.1493E 00	0.4867E-02
12	-0.9963E-01	-0.1489E 00	0.4707E-02
13	-0.1035E 00	-0.1485E 00	0.4546E-02
14	-0.1073E 00	-0.1481E 00	0.4381E-02
15	-0.1109E 00	-0.1477E 00	0.4211E-02
16	-0.1144E 00	-0.1473E 00	0.4032E-02
17	-0.1177E 00	-0.1469E 00	0.3842E-02
18	-0.1209E 00	-0.1464E 00	0.3638E-02
19	-0.1239E 00	-0.1460E 00	0.3418E-02
20	-0.1267E 00	-0.1455E 00	0.3179E-02

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 412

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8075.	774.	16.	-1673.	16134.	3222.
2	8076.	485.	643.	-1774.	15509.	2744.
3	8078.	207.	1214.	-1881.	14941.	2294.
4	8079.	-61.	1728.	-1994.	14430.	1872.
5	8080.	-320.	2182.	-2116.	13978.	1477.
6	8081.	-569.	2576.	-2247.	13586.	1109.
7	8083.	-810.	2909.	-2388.	13256.	768.
8	8084.	-1044.	3180.	-2541.	12989.	453.
9	8086.	-1270.	3386.	-2705.	12786.	165.
10	8088.	-1489.	3528.	-2881.	12648.	-96.
11	8090.	-1701.	3603.	-3071.	12576.	-331.
12	8091.	-1906.	3611.	-3274.	12572.	-538.
13	8093.	-2105.	3551.	-3490.	12636.	-719.
14	8096.	-2297.	3422.	-3721.	12769.	-872.
15	8098.	-2481.	3222.	-3966.	12973.	-997.
16	8100.	-2659.	2952.	-4224.	13248.	-1093.
17	8103.	-2828.	2609.	-4497.	13596.	-1160.
18	8105.	-2990.	2194.	-4783.	14016.	-1197.
19	8108.	-3142.	1705.	-5082.	14511.	-1203.
20	8110.	-3285.	1140.	-5393.	15080.	-1177.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 412   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	8097.		1690.		16134.	
2	8095.		2418.		15509.	
3	8093.		3095.		14941.	
4	8146.		3722.		14430.	
5	8404.		4298.		13978.	
6	8654.		4824.		13586.	
7	8895.		5298.		13256.	
8	9129.		5720.		12989.	
9	9356.		6091.		12786.	
10	9577.		6409.		12744.	
11	9790.		6674.		12907.	
12	9998.		6885.		13110.	
13	10198.		7041.		13355.	
14	10393.		7143.		13641.	
15	10581.		7188.		13970.	
16	10761.		7176.		14341.	
17	10935.		7106.		14756.	
18	11100.		6976.		15213.	
19	11257.		6786.		15713.	
20	11405.		6534.		16257.	

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11595.	10930.	-158.	-51.	-45.
2	11595.	10374.	-197.	-63.	-54.
3	11595.	9820.	-243.	-77.	-63.
4	11596.	9268.	-297.	-93.	-74.
5	11596.	8717.	-360.	-112.	-85.
6	11596.	8168.	-432.	-134.	-97.
7	11597.	7623.	-513.	-158.	-110.
8	11597.	7080.	-606.	-186.	-124.
9	11597.	6541.	-710.	-218.	-139.
10	11598.	6007.	-825.	-252.	-154.
11	11599.	5478.	-954.	-291.	-171.
12	11599.	4954.	-1095.	-334.	-188.
13	11600.	4438.	-1250.	-380.	-206.
14	11601.	3930.	-1420.	-431.	-225.
15	11602.	3430.	-1605.	-487.	-244.
16	11603.	2941.	-1805.	-547.	-264.
17	11604.	2463.	-2022.	-612.	-285.
18	11605.	1998.	-2256.	-682.	-307.
19	11607.	1548.	-2507.	-757.	-329.
20	11608.	1113.	-2776.	-838.	-353.

II.6.2.159

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.9144E-01	-0.1582E 00	0.9058E-02
2	0.8406E-01	-0.1581E 00	0.9039E-02
3	0.7670E-01	-0.1581E 00	0.9017E-02
4	0.6935E-01	-0.1580E 00	0.8989E-02
5	0.6203E-01	-0.1579E 00	0.8955E-02
6	0.5474E-01	-0.1579E 00	0.8914E-02
7	0.4749E-01	-0.1577E 00	0.8865E-02
8	0.4027E-01	-0.1576E 00	0.8807E-02
9	0.3311E-01	-0.1575E 00	0.8739E-02
10	0.2600E-01	-0.1574E 00	0.8660E-02
11	0.1897E-01	-0.1572E 00	0.8567E-02
12	0.1200E-01	-0.1570E 00	0.8461E-02
13	0.5136E-02	-0.1568E 00	0.8340E-02
14	-0.1635E-02	-0.1566E 00	0.8201E-02
15	-0.8283E-02	-0.1564E 00	0.8044E-02
16	-0.1481E-01	-0.1562E 00	0.7867E-02
17	-0.2118E-01	-0.1560E 00	0.7669E-02
18	-0.2738E-01	-0.1557E 00	0.7447E-02
19	-0.3340E-01	-0.1554E 00	0.7200E-02
20	-0.3922E-01	-0.1552E 00	0.6925E-02

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.160
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8066.	7603.	7607.	7456.	8525.	7751.
2	8066.	7217.	7495.	7035.	8638.	7399.
3	8066.	6832.	7361.	6609.	8772.	7054.
4	8067.	6447.	7204.	6177.	8929.	6717.
5	8067.	6064.	7023.	5739.	9111.	6389.
6	8067.	5682.	6814.	5294.	9320.	6070.
7	8067.	5303.	6577.	4843.	9558.	5762.
8	8067.	4925.	6308.	4384.	9827.	5466.
9	8068.	4550.	6007.	3919.	10128.	5182.
10	8068.	4178.	5672.	3446.	10465.	4911.
11	8069.	3810.	5300.	2966.	10837.	4655.
12	8069.	3446.	4890.	2478.	11249.	4415.
13	8070.	3087.	4439.	1983.	11700.	4191.
14	8070.	2734.	3947.	1482.	12194.	3986.
15	8071.	2386.	3411.	973.	12731.	3800.
16	8072.	2046.	2829.	458.	13314.	3634.
17	8072.	1714.	2201.	-63.	13944.	3491.
18	8073.	1390.	1523.	-590.	14624.	3371.
19	8074.	1077.	795.	-1122.	15353.	3276.
20	8075.	774.	15.	-1659.	16136.	3208.

HANFORD NO. 2 CONTAINMENT VESSEL II.6.2.161
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	8067.		7607.		8525.	
2	8067.		7495.		8638.	
3	8067.		7361.		8772.	
4	8068.		7204.		8929.	
5	8069.		7023.		9111.	
6	8069.		6814.		9320.	
7	8070.		6577.		9558.	
8	8072.		6308.		9827.	
9	8073.		6007.		10128.	
10	8075.		5672.		10465.	
11	8076.		5300.		10837.	
12	8079.		4890.		11249.	
13	8081.		4439.		11700.	
14	8084.		3947.		12194.	
15	8087.		3411.		12731.	
16	8090.		2829.		13314.	
17	8094.		2264.		13944.	
18	8099.		2113.		14624.	
19	8103.		1917.		15353.	
20	8109.		1674.		16136.	

II.6.2.162

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11590.	25395.	-105.	-31.	147.
2	11590.	25345.	227.	68.	141.
3	11590.	25282.	545.	163.	135.
4	11590.	25191.	847.	254.	128.
5	11590.	25053.	1132.	340.	120.
6	11590.	24854.	1399.	420.	111.
7	11590.	24580.	1644.	493.	101.
8	11590.	24216.	1864.	559.	90.
9	11590.	23751.	2055.	616.	76.
10	11590.	23176.	2211.	663.	60.
11	11590.	22480.	2327.	698.	40.
12	11590.	21659.	2395.	718.	18.
13	11590.	20707.	2405.	721.	-10.
14	11590.	19626.	2347.	704.	-41.
15	11590.	18418.	2210.	663.	-79.
16	11590.	17091.	1980.	594.	-122.
17	11590.	15656.	1645.	493.	-171.
18	11590.	14133.	1187.	356.	-228.
19	11590.	12547.	592.	178.	-291.
20	11590.	10929.	-158.	-47.	-362.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.163

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.2816E 00	-0.1613E 00	0.2784E-03
2	0.2810E 00	-0.1611E 00	0.2973E-03
3	0.2802E 00	-0.1608E 00	0.4146E-03
4	0.2790E 00	-0.1606E 00	0.6258E-03
5	0.2772E 00	-0.1604E 00	0.9260E-03
6	0.2747E 00	-0.1601E 00	0.1310E-02
7	0.2711E 00	-0.1599E 00	0.1771E-02
8	0.2665E 00	-0.1597E 00	0.2303E-02
9	0.2605E 00	-0.1594E 00	0.2898E-02
10	0.2531E 00	-0.1591E 00	0.3545E-02
11	0.2441E 00	-0.1589E 00	0.4234E-02
12	0.2336E 00	-0.1586E 00	0.4950E-02
13	0.2214E 00	-0.1583E 00	0.5679E-02
14	0.2075E 00	-0.1580E 00	0.6401E-02
15	0.1920E 00	-0.1576E 00	0.7093E-02
16	0.1749E 00	-0.1573E 00	0.7730E-02
17	0.1565E 00	-0.1569E 00	0.8282E-02
18	0.1369E 00	-0.1565E 00	0.8714E-02
19	0.1165E 00	-0.1561E 00	0.8988E-02
20	0.9574E-01	-0.1556E 00	0.9057E-02

II.6.2.164

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8063.	17666.	7758.	17574.	8367.	17757.
2	8063.	17631.	8722.	17829.	7404.	17433.
3	8063.	17588.	9644.	18062.	6481.	17113.
4	8063.	17524.	10522.	18262.	5604.	16786.
5	8063.	17428.	11350.	18414.	4775.	16442.
6	8063.	17290.	12124.	18508.	4002.	16072.
7	8063.	17099.	12835.	18531.	3291.	15667.
8	8063.	16846.	13474.	18469.	2651.	15222.
9	8063.	16523.	14029.	18313.	2097.	14733.
10	8063.	16122.	14484.	18049.	1642.	14196.
11	8063.	15638.	14821.	17666.	1305.	13611.
12	8063.	15067.	15016.	17153.	1109.	12981.
13	8063.	14405.	15045.	16500.	1081.	12311.
14	8063.	13653.	14877.	15697.	1248.	11609.
15	8063.	12813.	14479.	14738.	1647.	10888.
16	8063.	11889.	13813.	13614.	2313.	10164.
17	8063.	10891.	12838.	12324.	3288.	9459.
18	8063.	9832.	11510.	10866.	4616.	8798.
19	8063.	8728.	9782.	9244.	6344.	8213.
20	8063.	7603.	7605.	7465.	8521.	7740.

II.6.2.165

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	17669.		17574.		17757.	
2	17634.		17829.		17433.	
3	17590.		18062.		17113.	
4	17526.		18262.		16786.	
5	17430.		18414.		16442.	
6	17292.		18508.		16072.	
7	17100.		18531.		15667.	
8	16847.		18469.		15222.	
9	16523.		18313.		14733.	
10	16123.		18049.		14196.	
11	15639.		17666.		13611.	
12	15067.		17153.		12981.	
13	14405.		16500.		12311.	
14	13653.		15697.		11609.	
15	12814.		14738.		10888.	
16	11891.		13813.		10164.	
17	10895.		12838.		9459.	
18	9839.		11510.		8798.	
19	8740.		9782.		8213.	
20	8098.		7605.		8521.	

II.6.2.166

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 500

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-0.	5951.	-0.	0.	-0.
2	10.	5941.	-0.	0.	-0.
3	19.	5931.	0.	0.	-0.
4	29.	5921.	0.	0.	-0.
5	39.	5912.	0.	0.	-0.
6	49.	5902.	0.	0.	-0.
7	58.	5892.	0.	0.	-0.
8	68.	5883.	0.	0.	-0.
9	77.	5873.	0.	0.	-0.
10	87.	5864.	0.	0.	-0.
11	96.	5854.	0.	0.	-0.
12	106.	5845.	0.	0.	-0.
13	115.	5836.	0.	0.	-0.
14	124.	5826.	0.	0.	-0.
15	134.	5817.	0.	0.	-0.
16	143.	5808.	0.	0.	-0.
17	152.	5799.	0.	0.	-0.
18	161.	5789.	0.	0.	-0.
19	170.	5780.	0.	0.	-0.
20	179.	5771.	0.	0.	-0.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.167

BODY NO. 500

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.1657E 00	0.2841E 00	0.2809E-03
2	0.1655E 00	0.2840E 00	0.2808E-03
3	0.1652E 00	0.2838E 00	0.2806E-03
4	0.1650E 00	0.2837E 00	0.2805E-03
5	0.1648E 00	0.2836E 00	0.2804E-03
6	0.1645E 00	0.2834E 00	0.2802E-03
7	0.1643E 00	0.2833E 00	0.2801E-03
8	0.1641E 00	0.2831E 00	0.2800E-03
9	0.1639E 00	0.2830E 00	0.2798E-03
10	0.1636E 00	0.2829E 00	0.2797E-03
11	0.1634E 00	0.2827E 00	0.2796E-03
12	0.1632E 00	0.2826E 00	0.2794E-03
13	0.1629E 00	0.2825E 00	0.2793E-03
14	0.1627E 00	0.2824E 00	0.2792E-03
15	0.1625E 00	0.2822E 00	0.2790E-03
16	0.1622E 00	0.2821E 00	0.2789E-03
17	0.1620E 00	0.2820E 00	0.2788E-03
18	0.1618E 00	0.2818E 00	0.2787E-03
19	0.1615E 00	0.2817E 00	0.2785E-03
20	0.1613E 00	0.2816E 00	0.2784E-03

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 500

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-1.	15869.	-1.	15872.	-1.	15866.
2	26.	15843.	26.	15846.	26.	15840.
3	52.	15816.	52.	15819.	52.	15813.
4	78.	15790.	78.	15793.	78.	15787.
5	104.	15764.	104.	15767.	104.	15761.
6	130.	15739.	130.	15742.	130.	15736.
7	155.	15713.	155.	15716.	155.	15710.
8	181.	15687.	181.	15690.	181.	15684.
9	206.	15662.	206.	15665.	206.	15659.
10	232.	15637.	232.	15640.	231.	15634.
11	257.	15611.	257.	15614.	257.	15609.
12	282.	15586.	282.	15589.	282.	15584.
13	307.	15561.	307.	15564.	307.	15559.
14	331.	15537.	332.	15540.	331.	15534.
15	356.	15512.	356.	15515.	356.	15509.
16	381.	15487.	381.	15490.	381.	15485.
17	405.	15463.	405.	15466.	405.	15460.
18	430.	15439.	430.	15441.	429.	15436.
19	454.	15414.	454.	15417.	454.	15412.
20	478.	15390.	478.	15393.	478.	15387.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 500 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	15870.		15873.		15867.	
2	15843.		15846.		15840.	
3	15816.		15819.		15813.	
4	15790.		15793.		15787.	
5	15764.		15767.		15761.	
6	15739.		15742.		15736.	
7	15713.		15716.		15710.	
8	15687.		15690.		15684.	
9	15662.		15665.		15659.	
10	15637.		15640.		15634.	
11	15611.		15614.		15609.	
12	15586.		15589.		15584.	
13	15561.		15564.		15559.	
14	15537.		15540.		15534.	
15	15512.		15515.		15509.	
16	15487.		15490.		15485.	
17	15463.		15466.		15460.	
18	15439.		15441.		15436.	
19	15414.		15417.		15412.	
20	15390.		15393.		15387.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.170

BODY NO. 502

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11591.	26107.	-403.	-121.	-2.
2	11591.	25876.	-395.	-118.	5.
3	11591.	25705.	-364.	-109.	10.
4	11591.	25590.	-320.	-96.	13.
5	11591.	25524.	-266.	-80.	14.
6	11591.	25499.	-209.	-63.	15.
7	11591.	25507.	-150.	-45.	15.
8	11591.	25538.	-93.	-28.	14.
9	11591.	25583.	-39.	-12.	13.
10	11591.	25634.	10.	3.	12.
11	11591.	25684.	55.	16.	11.
12	11591.	25725.	93.	28.	9.
13	11591.	25753.	123.	37.	7.
14	11591.	25761.	144.	43.	4.
15	11591.	25748.	152.	46.	1.
16	11591.	25711.	147.	44.	-4.
17	11591.	25651.	123.	37.	-9.
18	11591.	25573.	76.	23.	-15.
19	11591.	25484.	2.	1.	-23.
20	11591.	25395.	-105.	-31.	-32.

II.6.2.171

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 502

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.2908E 00	-0.1685E 00	0.8702E-03
2	0.2878E 00	-0.1681E 00	0.6653E-03
3	0.2856E 00	-0.1677E 00	0.4705E-03
4	0.2841E 00	-0.1673E 00	0.2951E-03
5	0.2833E 00	-0.1670E 00	0.1450E-03
6	0.2829E 00	-0.1666E 00	0.2337E-04
7	0.2830E 00	-0.1662E 00	-0.6845E-04
8	0.2834E 00	-0.1658E 00	-0.1307E-03
9	0.2840E 00	-0.1654E 00	-0.1644E-03
10	0.2847E 00	-0.1651E 00	-0.1716E-03
11	0.2853E 00	-0.1647E 00	-0.1547E-03
12	0.2858E 00	-0.1643E 00	-0.1167E-03
13	0.2862E 00	-0.1639E 00	-0.6127E-04
14	0.2863E 00	-0.1636E 00	0.7288E-05
15	0.2861E 00	-0.1632E 00	0.8354E-04
16	0.2857E 00	-0.1628E 00	0.1607E-03
17	0.2849E 00	-0.1624E 00	0.2304E-03
18	0.2839E 00	-0.1621E 00	0.2822E-03
19	0.2827E 00	-0.1617E 00	0.3033E-03
20	0.2816E 00	-0.1613E 00	0.2784E-03

II.2.12

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 502

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8063.	18162.	6894.	17811.	9232.	18512.
2	8063.	18000.	6917.	17657.	9209.	18344.
3	8063.	17881.	7005.	17564.	9121.	18199.
4	8063.	17801.	7134.	17523.	8991.	18080.
5	8063.	17756.	7289.	17524.	8837.	17988.
6	8063.	17739.	7456.	17557.	8669.	17920.
7	8063.	17744.	7626.	17613.	8500.	17875.
8	8063.	17765.	7792.	17684.	8334.	17847.
9	8063.	17797.	7949.	17762.	8177.	17831.
10	8063.	17832.	8093.	17841.	8033.	17823.
11	8063.	17867.	8222.	17915.	7904.	17819.
12	8063.	17896.	8332.	17977.	7794.	17815.
13	8063.	17915.	8420.	18022.	7706.	17808.
14	8063.	17921.	8480.	18046.	7646.	17796.
15	8063.	17911.	8506.	18044.	7620.	17779.
16	8063.	17886.	8489.	18013.	7637.	17758.
17	8063.	17844.	8419.	17951.	7707.	17738.
18	8063.	17790.	8283.	17856.	7843.	17724.
19	8063.	17728.	8068.	17729.	8058.	17726.
20	8063.	17666.	7759.	17575.	8367.	17757.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 502 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	18162.		17811.		18512.	
2	18000.		17657.		18344.	
3	17881.		17564.		18199.	
4	17801.		17523.		18080.	
5	17756.		17524.		17988.	
6	17739.		17557.		17920.	
7	17744.		17613.		17875.	
8	17765.		17684.		17847.	
9	17797.		17762.		17831.	
10	17832.		17841.		17823.	
11	17867.		17915.		17819.	
12	17896.		17977.		17815.	
13	17915.		18022.		17808.	
14	17921.		18046.		17796.	
15	17911.		18044.		17779.	
16	17886.		18013.		17758.	
17	17844.		17951.		17738.	
18	17790.		17856.		17724.	
19	17728.		17729.		17726.	
20	17666.		17575.		17757.	

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.2.174

BODY NO. 600

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11592.	23140.	-0.	-0.	0.
2	11592.	23255.	-1.	-0.	-0.
3	11592.	23369.	-2.	-1.	-0.
4	11592.	23484.	-5.	-1.	-0.
5	11592.	23601.	-6.	-2.	-0.
6	11592.	23718.	-7.	-2.	-0.
7	11592.	23838.	-6.	-2.	0.
8	11592.	23959.	-3.	-1.	1.
9	11592.	24080.	4.	1.	2.
10	11592.	24200.	15.	5.	3.
11	11592.	24317.	32.	10.	4.
12	11592.	24426.	54.	16.	6.
13	11592.	24522.	83.	25.	7.
14	11592.	24599.	117.	35.	9.
15	11592.	24649.	158.	47.	10.
16	11592.	24661.	202.	60.	10.
17	11592.	24626.	246.	74.	10.
18	11592.	24534.	286.	86.	8.
19	11592.	24375.	314.	94.	5.
20	11592.	24143.	322.	97.	-2.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.6.2.175

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 600

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.2766E 00	-0.1784E 00	-0.3692E-03
2	0.2783E 00	-0.1778E 00	-0.3694E-03
3	0.2799E 00	-0.1773E 00	-0.3706E-03
4	0.2815E 00	-0.1767E 00	-0.3732E-03
5	0.2831E 00	-0.1762E 00	-0.3774E-03
6	0.2848E 00	-0.1757E 00	-0.3826E-03
7	0.2865E 00	-0.1751E 00	-0.3878E-03
8	0.2882E 00	-0.1746E 00	-0.3914E-03
9	0.2899E 00	-0.1741E 00	-0.3911E-03
10	0.2916E 00	-0.1736E 00	-0.3841E-03
11	0.2932E 00	-0.1731E 00	-0.3666E-03
12	0.2947E 00	-0.1725E 00	-0.3345E-03
13	0.2961E 00	-0.1720E 00	-0.2833E-03
14	0.2972E 00	-0.1715E 00	-0.2082E-03
15	0.2979E 00	-0.1710E 00	-0.1046E-03
16	0.2980E 00	-0.1705E 00	0.3080E-04
17	0.2976E 00	-0.1700E 00	0.1998E-03
18	0.2963E 00	-0.1695E 00	0.4009E-03
19	0.2940E 00	-0.1690E 00	0.6284E-03
20	0.2908E 00	-0.1685E 00	0.8702E-03

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM

II.6.2.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 600

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8832.	17631.	8832.	17631.	8832.	17631.
2	8832.	17718.	8830.	17717.	8835.	17719.
3	8832.	17805.	8824.	17803.	8841.	17808.
4	8832.	17893.	8816.	17888.	8848.	17898.
5	8832.	17982.	8810.	17975.	8855.	17988.
6	8832.	18071.	8807.	18064.	8857.	18079.
7	8832.	18162.	8810.	18156.	8854.	18169.
8	8832.	18254.	8823.	18251.	8842.	18257.
9	8832.	18347.	8847.	18351.	8818.	18342.
10	8832.	18438.	8886.	18455.	8779.	18422.
11	8832.	18527.	8943.	18561.	8721.	18494.
12	8832.	18610.	9021.	18667.	8644.	18554.
13	8832.	18684.	9120.	18770.	8544.	18597.
14	8832.	18742.	9241.	18865.	8423.	18620.
15	8832.	18780.	9381.	18945.	8283.	18615.
16	8832.	18789.	9534.	19000.	8130.	18579.
17	8832.	18763.	9689.	19020.	7976.	18506.
18	8832.	18692.	9828.	18991.	7837.	18394.
19	8832.	18571.	9927.	18900.	7738.	18243.
20	8832.	18394.	9953.	18731.	7711.	18058.

HANFORD NO. 2 CONTAINMENT VESSEL
ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 600 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	17631.		17631.		17631.	
2	17718.		17717.		17719.	
3	17805.		17803.		17808.	
4	17893.		17888.		17898.	
5	17982.		17975.		17988.	
6	18071.		18064.		18079.	
7	18162.		18156.		18169.	
8	18254.		18251.		18257.	
9	18347.		18351.		18342.	
10	18438.		18455.		18422.	
11	18527.		18561.		18494.	
12	18610.		18667.		18554.	
13	18684.		18770.		18597.	
14	18742.		18865.		18620.	
15	18780.		18945.		18615.	
16	18789.		19000.		18579.	
17	18763.		19020.		18506.	
18	18692.		18991.		18394.	
19	18571.		18900.		18243.	
20	18394.		18731.		18058.	

SHELL TENSION DESIGN

THE PRECEDING COMPUTER ANALYSIS GIVES TENSILE STRESSES IN THE SHELL DUE TO INTERNAL PRESSURE, SUPPRESSION CHAMBER WATER AND ½ SSE DOWN. FROM THE SPECIFICATION (REFERENCE 1) THE MAXIMUM ½ SSE SHEAR FORCE IS 8.2×10^3 KIPS. THE MAXIMUM SHEAR STRESS IS:

$8.2\times10^6 / \cos 26.7813 * \pi * 496.117 * 1.4375 = 4100$ PSI

BY DEFINITION PRINCIPAL STRESSES ARE:

$$\sigma = \frac{S_x + S_y}{2} \pm \sqrt{\left(\frac{S_x - S_y}{2}\right)^2 + (S_{xy})^2}$$ TABLE II, CASE 5, IN ROARK

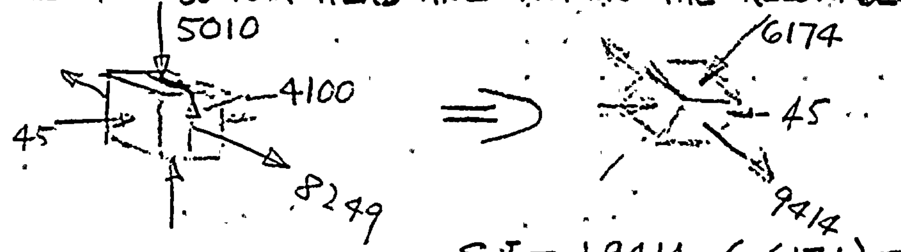
FOR THE BOTTOM HEAD THE MAXIMUM STRESS INTENSITY FROM THE BOTTOM OF THE SAND FILL TO THE BELT SEAM WILL OCCUR IN BODY 410 (SEE P. 148 STATION 15 OF THIS ARTICLE).

$S_x = 8249 \quad S_y = -5010 \quad S_{xy} = 4100$

$$P.S. = \frac{8249 - 5010}{2} \pm \sqrt{\left(\frac{8249 + 5010}{2}\right)^2 + 4100^2}$$

S.I. = 15,590. PSI < 19300 PSI

ALSO, DISCONTINUITY STRESSES AND MEMBRANE STRESSES IN THE BOTTOM HEAD ARE WITHIN THE ALLOWABLE LIMITS ∴ OK



$S.I. = +9414 - (-6174) = 15,588 \approx 15,590$

PITTSBURGH - DES MOINES STEEL CO. CONTRACT NO. 12764				FINAL STRESS REPORT	SECTION: II
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EXTERNAL PRESSURE

THE BOTTOM HEAD IS SUBJECTED TO A 4PSIG EXTERNAL PRESSURE FROM THE BELT SEAM TO THE TOP OF THE INSIDE CONCRETE. THERE IS A POSSIBILITY OF BUCKLING IN THIS AREA SINCE THERE IS NO CONCRETE SUPPORT. ASSUME THE SHELL TO ACT AS A FORMED HEAD AND BASE THE DESIGN ON PARAGRAPH NE-3133.4, REF. 2.

$T = 1.4375$ $R = 931.25''$ $R/100t = 6.478$ ✓

FROM FIGURE VIII -1100-2 OF REFERENCE 2,

$B = 2700$ ✓

$P_A = B/R/t = 4.17 > 4.0$ OK ✓

LONGITUDINAL COMPRESSION

THE ONLY AREA OF THE BOTTOM HEAD WHICH MUST BE ANALYZED FOR COMPRESSION IS FROM THE BELT SEAM DOWN TO THE TOP OF THE INSIDE CONCRETE (EL. 446-0). THE ANALYSIS WILL BE BASED ON THE INCIDENT LOAD CONDITION FROM PARAGRAPH 3.4.1.6 OF REFERENCE 1. THE TWO CONDITIONS WHICH WILL BE USED FOR THIS ANALYSIS ARE SSE EARTHQUAKE AND THE NEGATIVE 2 PSIG INTERNAL PRESSURE AT 135°F. THE FOLLOWING LOADS ARE ALL TAKEN FROM SECTION II, SUBSEC 8, ARTICLE 1, P. 139. *

1. WELDING PAD L.L. = 3000 K
2. PLATFORM L.L. = 3488 K
3. VESSEL D.L. (FROM SECTION II, SUBSEC 3, ARTICLE 1)
   = 4389.1 K AT EL. 446-0
4. FILLER MAT'L DL = 87.1 K
5. REFUELING BELLOWS = 209.9 K
6. PIPE RUPTURE = 561 K } USE LARGER OF
7. JET LOAD = 534 K }
8. SEAL LOAD = 111.1 K

FROM REFERENCE 1, THE MAX VERTICAL EQ

* THESE LOADS ARE ALL TAKEN FROM II.8.1.136-138

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FACTOR IS 0.45. MULTIPLYING ITEMS . 3. [illegible] AND 5 BY THIS FACTOR THE TOTAL GRAVITY LOAD IS:

GL = 1.45 (3000 + 4389.1 187.1 + 1111.7 + 249.9) + 8488 + 561

GL = 21863.8K

THE NEGATIVE 2 PSIG INTERNAL PRESSURE ADDS A LONGITUDINAL COMPRESSIVE LOAD OF $P * \pi R^2$ = $(2)(\pi)(514.5)^2/1000$ = 1663.2 K. FROM FIGURE [illegible] OF REFERENCE 1 THE SSE MOMENT AT EL 446-0 = 636×10^3 FT-K.

THE FILLER MATERIAL ALSO ADDS A 2 PSIG EXTERNAL PRESSURE LOAD OVER AN AREA OF $\pi(514.5^2 - 190^2)$ OR THE EFFECTIVE LOAD IS 1436.4 K.

∴ P = 21863.8 + 1663.2 + 1436.4 = 24963.4K

USING THE THICKNESSES REQUIRED FOR INTERNAL PRESSURE, AND 80 STRUCTURAL T's FOR ADDITIONAL SUPPORT THE TOTAL AREA AND MOMENT OF INERTIA ARE:

$A_s = 2\pi R_M t + 80 * A$

$I_s = \pi R_M^3 t + A d^2$

FOR WT 8×18 $A = 5.3\ IN^2$ $I = 30.8\ IN^4$

FOR T's, $d^2 = 2((r)(\cos 0°))^2 + 4 * [(r * \cos 4\tfrac{1}{2}°)^2 + (r * \cos 9°)^2 + (r * \cos 13\tfrac{1}{2}°)^2 + \ldots\ldots + (r * \cos 81°)^2 + (r * \cos 85\tfrac{1}{2}°)^2] + 2(r * \cos 90°)^2$

FOR ABOVE T's, $r = 509.65 - .71875 - 7.93 + 1.89 - 0.0625$

$r = 502.83$ IN

$d^2 = 10{,}113{,}520$ IN^2

AT EL. 446-0: $Ad^2 = 53{,}601{,}656$ $R_M = 509.65$

$t = 1.4375$ (CORRODED)

$A_S = 80 * 5.3 + 2\pi * 509.65 * 1.4375 = 5027.2$ IN^2

$I_S = 53{,}601{,}656 + \pi(509.65)^3 * 1.4375 = 651.43 \times 10^6$ IN^4

$$\sigma_{TOTAL} = \frac{My}{I_S} + \frac{P}{A_S} = \frac{636 \times 10^6 * 12 * 510.39}{651.43 \times 10^6 * \cos 14.1232} + \frac{24963.4 * 10^3}{5027.2 * \cos 14.1423}$$

$\sigma_{TOTAL} = 11301.5$ PSI COMPRESSION.

ASSUMING THE UPPER PART OF THE HEAD IS EFFECTIVELY A VERTICALLY STIFFENED SHELL WITH A R_M OF 509.65 THE SHELL-T COMBINED VERTICAL STIFFENER USING THE AISC MANUAL (REFERENCE 3) AS A FORMAT.

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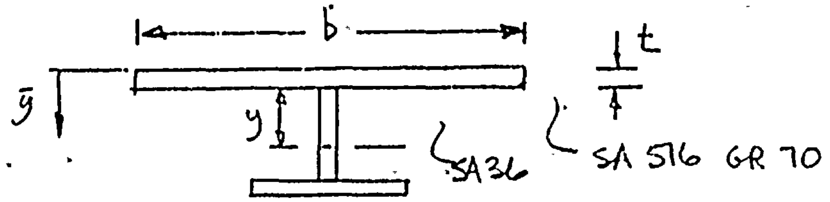

$y = \frac{1}{16} + 7.93 - 1.89 = 6.10''$

b IS EQUAL TO THE SMALLER OF $2t * 95/\sqrt{F_y}$ OR $2\pi R_M/180$ WHERE THE FIRST FORMULA IS FROM REF. 3. USE F_y FROM REF. 2 AT 135°F OR $F_y = 36.81$ KSI

$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = 128.68$ $E = 27.9 \times 10^6$ psi & $F_y = 33260$ psi AT 340°F, BOTH FROM REF. 2.

TOTAL COLUMN LENGTH FROM RING STIFFENER TO EL. 446-0 =

453-4 − 446-0 = 88 IN

ASSUME K = 1.0 i.e. A PINNED-PINNED COLUMN

FOR EFFECTIVE SECTION:

$t = 1.4375$ $b = 40.03$ $A = 62.84$ $\bar{y} = 1.294$ $I = 266.35$

$r = \sqrt{I/A} = 2.06$ $KL/r = 88.0/2.06 = 42.72$

F_A 17.59 > 11.28 KSI

∴ BOTTOM HEAD FROM BELT SEAM DOWN TO THE INSIDE CONCRETE IS OK FOR LONGITUDINAL COMPRESSION.

AXZ AXISYMMETRIC MODEL OF LOCA CONDITIONS (THERMAL + PRESSURE)

THE BOTTOM HEAD FROM THE TOP OF THE INSIDE CONCRETE (EL. 446-0) TO THE BELT SEAM (EL. 449 8½) IS MODELLED AS SHOWN ON THE FOLLOWING PAGE FOR PDM'S AXISYMMETRIC SHELL PROGRAM AXZ (SEE APPENDIX II, ARTICLE 1 OF THIS FINAL STRESS REPORT). THE SUPPRESSION CHAMBER CYLINDER IS INCLUDED UP TO THE MAX. WATER LEVEL FOR DISCONTINUITY EFFECTS BUT ITS SPECIFIC DESIGN IS NOT INCLUDED HERE.

THE INSIDE TOP OF THE CONCRETE (NODE 411) IS ASSUMED TO BE A FIXITY BECAUSE THE VERTICAL T-STIFFENERS ARE FULLY EMBEDDED IN THE CONCRETE AND ARE SPACED AN EFFECTIVE LENGTH APART.

THE ENTIRE MODEL IS SUBJECTED TO BOTH A UNIFORM TEMPERATURE OF 205°F* AND PRESSURE LOADINGS FROM THE LOCA CASE (SEE ARTICLE 2). THE MODEL WAS SUBJECTED TO THESE TWO LOADINGS SEPERATELY.

FOR A DISCUSSION OF THE MODELING OF THE BOTTOM KNUCKLE AND OF THE [illegible] BETWEEN ELEMENTS OF DIFFERENT THICKNESS, SEE ARTICLE 2.

*275°F − 70°F = 205°F (70°F AMBIENT)

PITTSBURGH - DES MOINES STEEL CO. CONTRACT NO. 12764 WPPSS HANFORD NO. 2 CONTAINMENT VESSEL				FINAL STRESS REPORT	SECTION: II
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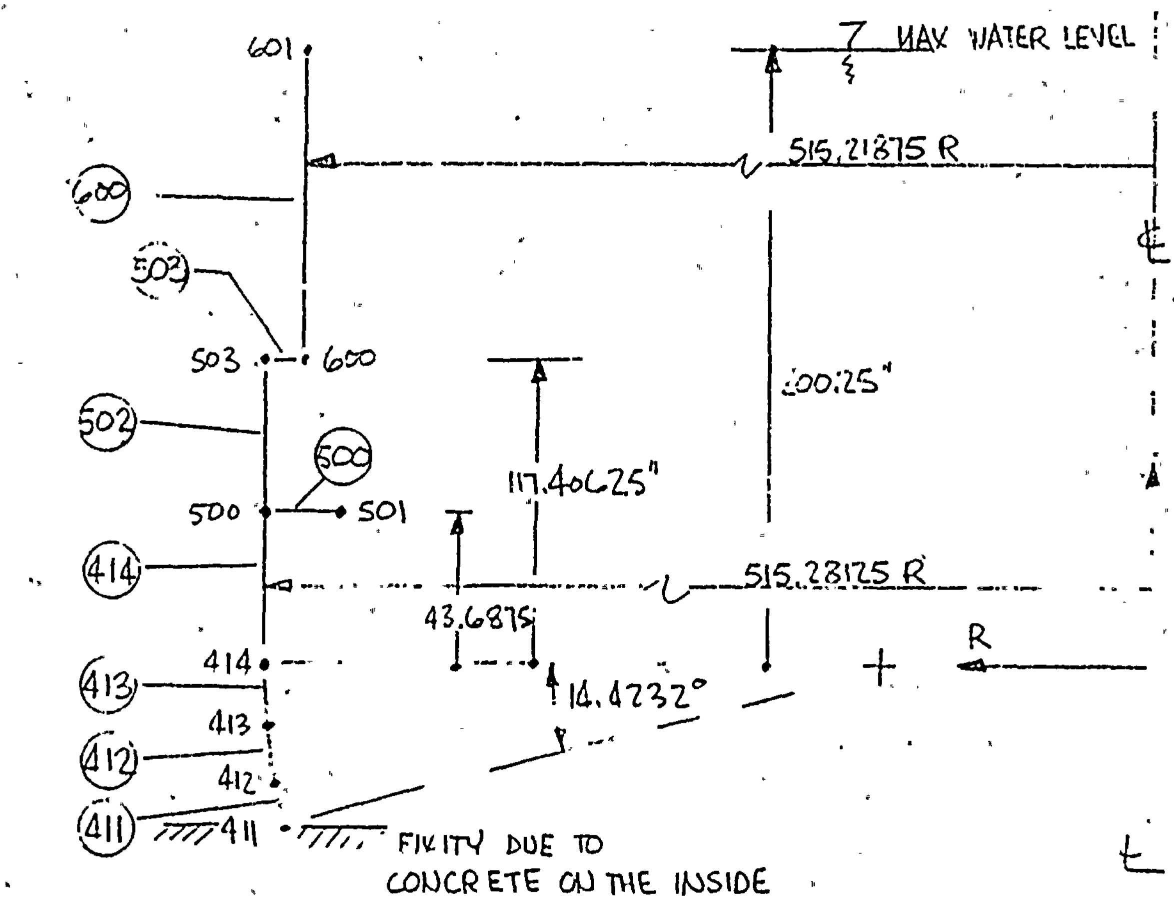
AXZ AXISYMMETRIC THERMAL & PRESSURE MODEL



NOTE: THERE IS A CONSTANT THERMAL LOAD OF 205°F ON ALL BODIES EXCEPT 503. BODY NUMBERS ARE CIRCLED. END CAP LOADS, INTERNAL PRESSURE OF 45 P[illegible] AND [illegible] WATER WITH 1/2 SSE EARTHQUAKE ARE ALSO IMPOSED ON THIS MODEL TO OBTAIN THE PEAK STRESS INTENSITY.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.3

HANFORD NO. 2 CONTAINMENT VESSEL

NUMBER OF NODES = 9 NUMBER OF BODIES = 8

NODE NO.	COORDINATE R	COORDINATE Z	OBLIQUE AXIS ANGLE	FIXITY CODE
411	0.509650E 03	-0.444996E 02	0.0	111
412	0.512771E 03	-0.298413E 02	0.0	0
413	0.514653E 03	-0.149730E 02	0.0	0
414	0.515281E 03	0.0	0.0	0
500	0.515281E 03	0.436875E 02	0.0	0
501	0.499500E 03	0.436875E 02	0.0	0
503	0.515281E 03	0.117406E 03	0.0	0
600	0.515219E 03	0.117406E 03	0.0	0
601	0.515219E 03	0.200250E 03	0.0	0

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.4

HANFORD NO. 2 CONTAINMENT VESSEL

NODE NO.	ELASTIC FOUNDATION CONSTANTS R-DIR.	Z-DIR.	ROTATION
411	0.0	0.0	0.0
412	0.0	0.0	0.0
413	0.0	0.0	0.0
414	0.0	0.0	0.0
500	0.0	0.0	0.0
501	0.0	0.0	0.0
503	0.0	0.0	0.0
600	0.0	0.0	0.0
601	0.0	0.0	0.0

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.B5

HANFORD NO. 7 CONTAINMENT VESSEL

NODE NO.	PRESCRIBED DISPLACEMENTS R-DIR.	Z-DIR.	ROTATION
411	0.0	0.0	0.0
412	0.0	0.0	0.0
413	0.0	0.0	0.0
414	0.0	0.0	0.0
500	0.0	0.0	0.0
501	0.0	0.0	0.0
503	0.0	0.0	0.0
600	0.0	0.0	0.0
601	0.0	0.0	0.0

II.6.3.6

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

HANFORD NO. 2 CONTAINMENT VESSEL

BODY NO. 411 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 412 AND 411

THICKNESS = 0.143750E 01 RADIUS = 0.522724E 03

ANGLE PHI-A = 0.101199E 03 ANGLE PHI-B = 0.102842E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 412 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 413 AND 412

THICKNESS = 0.143750E 01 RADIUS = 0.517865E 03

ANGLE PHI-A = 0.963845E 02 ANGLE PHI-B = 0.980427E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 413 -- BODY TYPE 4, OPEN CROWN SEGMENT OF A SPHERE

EDGE NODES ARE 414 AND 413

THICKNESS = 0.143750E 01 RADIUS = 0.515474E 03

ANGLE PHI-A = 0.915686E 02 ANGLE PHI-B = 0.932344E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 414 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 500 AND 414 THICKNESS = 0.143750E 01

RADIUS = 0.515281E 03 LENGTH = 0.436875E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER.

HANFORD NO. 2 CONTAINMENT VESSEL

BODY NO. 502 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 503 AND 500 THICKNESS = 0.143750E 01

RADIUS = 0.515281E 03 LENGTH = 0.737188E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 600 -- BODY TYPE 1, CYLINDER

EDGE NODES ARE 601 AND 600 THICKNESS = 0.131250E 01

RADIUS = 0.515219E 03 LENGTH = 0.828438E 02

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 500 -- BODY TYPE 3, FLAT ANNULUS

EDGE NODES ARE 501 AND 500 THICKNESS = 0.375000E 00

INSIDE RADIUS =0.499500E 03 OUTSIDE RADIUS = 0.515281E 03

E = 0.279000E 08 NU = 0.300000E 00 ALPHA = 0.650000E-05

BODY NO. 503 -- BODY TYPE 9, RIGID CONNECTOR

EDGE NODES ARE 600 AND 503

II-G.38

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

HANFORD NO. 2 CONTAINMENT VESSEL

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 411   BODY TYPE   4   X = MERIDIAN ANGLE
      PN = ( 0.556100E 02) + ( 0.0          )*COS(X)
        + ( 0.0          )*COS(X)*COS(X)
      PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
      T = ( 0.0          + ( 0.0          )*Z/H)
       + ( 0.0          + ( 0.0          )*Z/H)*X
       + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 412   BODY TYPE   4   X = MERIDIAN ANGLE
      PN = ( 0.549700E 02) + ( 0.0          )*COS(X)
        + ( 0.0          )*COS(X)*COS(X)
      PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
      T = ( 0.0          + ( 0.0          )*Z/H)
       + ( 0.0          + ( 0.0          )*Z/H)*X
       + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 413   BODY TYPE   4   X = MERIDIAN ANGLE
      PN = ( 0.543300E 02) + ( 0.0          )*COS(X)
        + ( 0.0          )*COS(X)*COS(X)
      PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
      T = ( 0.0          + ( 0.0          )*Z/H)
       + ( 0.0          + ( 0.0          )*Z/H)*X
       + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

II.6.3.9

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

HANFORD NO. 2 CONTAINMENT VESSEL

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

```
BODY NO. 414  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.517820E 02) + ( 0.433000E-01)*X
     PPHI = ( 0.0          ) + ( 0.0          )*X
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 502  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.485900E 02) + ( 0.433000E-01)*X
     PPHI = ( 0.0          ) + ( 0.0          )*X
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 600  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.450000E 02) + ( 0.433000E-01)*X
     PPHI = ( 0.0          ) + ( 0.0          )*X
     T = ( 0.0          + ( 0.0          )*Z/H)
      + ( 0.0          + ( 0.0          )*Z/H)*X
      + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.10

HANFORD NO. 2 CONTAINMENT VESSEL

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY LOADS

BODY NO. 500 BODY TYPE 3 X = RADIUS

```
    PN = ( 0.0          ) + ( 0.0          )*X
    PPHI = ( 0.0          ) + ( 0.0          )*X
    T = ( 0.0          + ( 0.0          )*Z/H)
     + ( 0.0          + ( 0.0          )*Z/H)*X
     + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

II-G-3-11

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

HANFORD NO. 2 CONTAINMENT VESSEL

VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER
CIRCUMFERENTIAL LINE LOADS

NODE	R-DIR.	Z-DIR.	MOMENT
411	0.0	0.0	0.0
412	0.0	0.0	0.0
413	0.0	0.0	0.0
414	0.0	0.0	0.0
500	0.0	0.0	0.0
501	0.0	0.0	0.0
503	0.0	0.0	0.0
600	0.0	0.0	0.0
601	0.0	0.115924E 05	0.0

II-6.312

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

NODE NO.	NODE DISPLACEMENTS R OR R' DIR.	Z OR Z' DIR.	ROTATION	OBLIQUE AXIS ANGLE
411	0.0	0.0	0.0	0.0
412	-0.172949E-01	0.775603E-02	-0.934912E-03	0.0
413	0.292777E-02	0.946901E-02	0.403584E-02	0.0
414	0.993168E-01	0.910384E-02	0.789373E-02	0.0
500	0.279231E 00	0.149094E-01	0.441215E-03	0.0
501	0.281724E 00	0.219035E-01	0.445223E-03	0.0
503	0.290807E 00	0.220805E-01	0.864507E-03	0.0
600	0.290807E 00	0.221346E-01	0.864507E-03	0.0
601	0.276650E 00	0.320043E-01	-0.368977E-03	0.0

II.6.3.13

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

NODE NO.	REACTION LOADS R OR R' DIR.	REACTION LOADS Z OR Z' DIR.	MOMENT	OBLIQUE AXIS ANGLE
411	-0.249062E 04	-0.114063E 05	0.228424E 04	0.0

II.6.3.14

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 411

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11630.	2136.	-2363.	-706.	520.
2	11632.	2198.	-1962.	-586.	497.
3	11634.	2271.	-1579.	-470.	475.
4	11637.	2354.	-1214.	-360.	452.
5	11639.	2445.	-867.	-256.	429.
6	11641.	2542.	-537.	-157.	407.
7	11643.	2642.	-225.	-63.	385.
8	11645.	2743.	70.	26.	363.
9	11648.	2844.	347.	109.	341.
10	11650.	2943.	607.	187.	319.
11	11652.	3038.	851.	260.	297.
12	11655.	3127.	1077.	327.	276.
13	11657.	3210.	1286.	390.	254.
14	11659.	3285.	1478.	447.	233.
15	11662.	3350.	1654.	499.	212.
16	11664.	3405.	1813.	546.	191.
17	11667.	3449.	1956.	589.	170.
18	11669.	3480.	2082.	626.	149.
19	11672.	3498.	2191.	658.	128.
20	11675.	3503.	2284.	685.	107.

II-6.3.15

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 411

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	-0.1847E-01	-0.4250E-02	-0.9349E-03
2	-0.1764E-01	-0.4007E-02	-0.1160E-02
3	-0.1665E-01	-0.3766E-02	-0.1344E-02
4	-0.1553E-01	-0.3526E-02	-0.1489E-02
5	-0.1431E-01	-0.3289E-02	-0.1597E-02
6	-0.1302E-01	-0.3054E-02	-0.1670E-02
7	-0.1168E-01	-0.2822E-02	-0.1709E-02
8	-0.1032E-01	-0.2592E-02	-0.1717E-02
9	-0.8974E-02	-0.2365E-02	-0.1696E-02
10	-0.7653E-02	-0.2140E-02	-0.1646E-02
11	-0.6380E-02	-0.1918E-02	-0.1570E-02
12	-0.5178E-02	-0.1698E-02	-0.1470E-02
13	-0.4064E-02	-0.1481E-02	-0.1348E-02
14	-0.3054E-02	-0.1266E-02	-0.1204E-02
15	-0.2167E-02	-0.1052E-02	-0.1041E-02
16	-0.1414E-02	-0.8398E-03	-0.8608E-03
17	-0.8096E-03	-0.6288E-03	-0.6648E-03
18	-0.3656E-03	-0.4189E-03	-0.4549E-03
19	-0.9203E-04	-0.2097E-03	-0.2328E-03
20	0.1967E-05	-0.7153E-06	-0.2608E-07

II.6.316

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 411

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8091.	1486.	1229.	-565.	14952.	3538.
2	8092.	1529.	2395.	-172.	13789.	3229.
3	8094.	1580.	3508.	215.	12679.	2945.
4	8095.	1638.	4569.	592.	11621.	2684.
5	8097.	1701.	5580.	959.	10613.	2444.
6	8098.	1768.	6539.	1314.	9657.	2223.
7	8100.	1838.	7446.	1655.	8753.	2020.
8	8101.	1908.	8304.	1983.	7898.	1834.
9	8103.	1978.	9111.	2295.	7095.	1662.
10	8104.	2047.	9868.	2590.	6341.	1505.
11	8106.	2113.	10576.	2867.	5636.	1359.
12	8108.	2175.	11234.	3125.	4981.	1225.
13	8109.	2233.	11843.	3364.	4376.	1102.
14	8111.	2285.	12403.	3583.	3818.	987.
15	8113.	2330.	12915.	3780.	3310.	881.
16	8114.	2369.	13379.	3955.	2850.	782.
17	8116.	2399.	13795.	4108.	2438.	690.
18	8118.	2421.	14162.	4238.	2074.	604.
19	8120.	2434.	14482.	4344.	1757.	523.
20	8121.	2437.	14754.	4426.	1489.	447.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II.C.3.17

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 411 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	8163.		1794.		14952.	
2	8158.		2566.		13789.	
3	8154.		3508.		12679.	
4	8150.		4569.		11621.	
5	8146.		5580.		10613.	
6	8143.		6539.		9657.	
7	8139.		7446.		8753.	
8	8136.		8304.		7898.	
9	8134.		9111.		7095.	
10	8132.		9868.		6341.	
11	8130.		10576.		5636.	
12	8128.		11234.		4981.	
13	8127.		11843.		4376.	
14	8125.		12403.		3818.	
15	8125.		12915.		3310.	
16	8124.		13379.		2850.	
17	8124.		13795.		2438.	
18	8124.		14162.		2074.	
19	8124.		14482.		1757.	
20	8124.		14754.		1489.	

II.C.3.18

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 412

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11610.	3711.	-3718.	-1121.	295.
2	11611.	3475.	-3493.	-1054.	275.
3	11612.	3261.	-3285.	-991.	254.
4	11613.	3068.	-3093.	-933.	234.
5	11615.	2894.	-2917.	-879.	212.
6	11616.	2739.	-2759.	-831.	191.
7	11617.	2601.	-2617.	-788.	170.
8	11619.	2480.	-2492.	-751.	148.
9	11620.	2374.	-2384.	-718.	126.
10	11622.	2284.	-2294.	-690.	104.
11	11623.	2208.	-2221.	-668.	81.
12	11625.	2146.	-2166.	-651.	59.
13	11627.	2098.	-2129.	-640.	37.
14	11629.	2064.	-2109.	-633.	14.
15	11631.	2042.	-2107.	-632.	-8.
16	11633.	2034.	-2122.	-637.	-31.
17	11635.	2040.	-2156.	-646.	-53.
18	11637.	2059.	-2207.	-661.	-76.
19	11639.	2092.	-2276.	-682.	-98.
20	11641.	2140.	-2363.	-707.	-121.

II.6.3.19

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 412

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.1858E-02	-0.9736E-02	0.4036E-02
2	-0.1186E-02	-0.9529E-02	0.3662E-02
3	-0.3944E-02	-0.9316E-02	0.3310E-02
4	-0.6432E-02	-0.9099E-02	0.2979E-02
5	-0.8668E-02	-0.8876E-02	0.2667E-02
6	-0.1066E-01	-0.8650E-02	0.2372E-02
7	-0.1243E-01	-0.8420E-02	0.2093E-02
8	-0.1399E-01	-0.8186E-02	0.1827E-02
9	-0.1534E-01	-0.7949E-02	0.1574E-02
10	-0.1650E-01	-0.7710E-02	0.1331E-02
11	-0.1746E-01	-0.7469E-02	0.1097E-02
12	-0.1825E-01	-0.7226E-02	0.8693E-03
13	-0.1886E-01	-0.6982E-02	0.6464E-03
14	-0.1929E-01	-0.6736E-02	0.4262E-03
15	-0.1955E-01	-0.6490E-02	0.2074E-03
16	-0.1964E-01	-0.6243E-02	-0.1221E-04
17	-0.1955E-01	-0.5996E-02	-0.2344E-03
18	-0.1929E-01	-0.5750E-02	-0.4609E-03
19	-0.1884E-01	-0.5504E-02	-0.6938E-03
20	-0.1821E-01	-0.5260E-02	-0.9349E-03

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER . II.63.20
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 412

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8077.	2582.	-2718.	-674.	18871.	5838.
2	8077.	2418.	-2066.	-641.	18220.	5477.
3	8078.	2269.	-1460.	-608.	17616.	5145.
4	8079.	2134.	-902.	-573.	17059.	4842.
5	8080.	2013.	-391.	-540.	16551.	4567.
6	8081.	1905.	71.	-509.	16090.	4319.
7	8082.	1810.	484.	-480.	15679.	4099.
8	8083.	1725.	847.	-454.	15318.	3904.
9	8084.	1652.	1161.	-433.	15006.	3736.
10	8085.	1589.	1424.	-416.	14746.	3594.
11	8086.	1536.	1636.	-404.	14536.	3476.
12	8087.	1493.	1798.	-398.	14377.	3384.
13	8088.	1460.	1908.	-398.	14269.	3317.
14	8090.	1436.	1967.	-403.	14212.	3275.
15	8091.	1421.	1974.	-415.	14208.	3257.
16	8092.	1415.	1930.	-433.	14255.	3264.
17	8094.	1419.	1834.	-458.	14353.	3296.
18	8095.	1432.	1687.	-488.	14504.	3352.
19	8097.	1455.	1488.	-523.	14706.	3434.
20	8098.	1489.	1237.	-565.	14959.	3542.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

II.6.3.21

BODY NO. 412 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE. SI	MID-SURFACE. T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	8100.		2718.		18871.	
2	8098.		2066.		18220.	
3	8095.		1460.		17616.	
4	8094.		902.		17059.	
5	8092.		540.		16551.	
6	8090.		579.		16090.	
7	8089.		963.		15679.	
8	8088.		1301.		15318.	
9	8088.		1593.		15006.	
10	8088.		1840.		14746.	
11	8088.		2040.		14536.	
12	8088.		2196.		14377.	
13	8089.		2306.		14269.	
14	8090.		2370.		14212.	
15	8091.		2390.		14208.	
16	8093.		2363.		14255.	
17	8095.		2292.		14353.	
18	8097.		2175.		14504.	
19	8099.		2011.		14706.	
20	8102.		1802.		14959.	

II.6.3.22

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413

STATION	STRESS RESULTANTS N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11597.	11210.	-874.	-265.	-73.
2	11598.	10728.	-935.	-283.	-81.
3	11598.	10252.	-1002.	-304.	-90.
4	11598.	9783.	-1077.	-326.	-100.
5	11598.	9320.	-1160.	-351.	-110.
6	11599.	8865.	-1251.	-379.	-122.
7	11599.	8418.	-1352.	-409.	-133.
8	11599.	7979.	-1462.	-442.	-146.
9	11600.	7550.	-1583.	-478.	-159.
10	11600.	7130.	-1714.	-518.	-173.
11	11601.	6722.	-1856.	-561.	-188.
12	11602.	6325.	-2010.	-607.	-203.
13	11602.	5941.	-2176.	-657.	-219.
14	11603.	5571.	-2355.	-710.	-235.
15	11604.	5216.	-2547.	-768.	-252.
16	11605.	4877.	-2753.	-829.	-269.
17	11606.	4556.	-2972.	-895.	-287.
18	11607.	4253.	-3206.	-965.	-305.
19	11608.	3971.	-3454.	-1039.	-324.
20	11609.	3711.	-3718.	-1118.	-343.

II.C3.23

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.9903E-01	-0.1182E-01	0.7894E-02
2	0.9283E-01	-0.1180E-01	0.7800E-02
3	0.8669E-01	-0.1177E-01	0.7700E-02
4	0.8064E-01	-0.1173E-01	0.7592E-02
5	0.7468E-01	-0.1168E-01	0.7476E-02
6	0.6881E-01	-0.1162E-01	0.7350E-02
7	0.6305E-01	-0.1154E-01	0.7215E-02
8	0.5739E-01	-0.1145E-01	0.7069E-02
9	0.5186E-01	-0.1135E-01	0.6911E-02
10	0.4645E-01	-0.1124E-01	0.6740E-02
11	0.4119E-01	-0.1112E-01	0.6555E-02
12	0.3608E-01	-0.1099E-01	0.6354E-02
13	0.3113E-01	-0.1085E-01	0.6137E-02
14	0.2636E-01	-0.1070E-01	0.5902E-02
15	0.2179E-01	-0.1054E-01	0.5647E-02
16	0.1742E-01	-0.1037E-01	0.5372E-02
17	0.1328E-01	-0.1020E-01	0.5075E-02
18	0.9378E-02	-0.1001E-01	0.4754E-02
19	0.5743E-02	-0.9819E-02	0.4408E-02
20	0.2389E-02	-0.9619E-02	0.4036E-02

II.6.3.24

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413

STATION	MEMBRANE STRESSES.		MEMBRANE + BENDING ON EXTREME FIBERS OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8068.	7798.	5530.	7028.	10606.	8568.
2	8068.	7463.	5354.	6640.	10782.	8286.
3	8068.	7132.	5158.	6250.	10978.	8014.
4	8068.	6805.	4941.	5858.	11195.	7753.
5	8068.	6484.	4700.	5464.	11436.	7504.
6	8069.	6167.	4435.	5067.	11702.	7267.
7	8069.	5856.	4143.	4668.	11994.	7044.
8	8069.	5551.	3824.	4267.	12315.	6835.
9	8069.	5252.	3474.	3863.	12664.	6641.
10	8070.	4960.	3094.	3457.	13046.	6464.
11	8070.	4676.	2681.	3049.	13459.	6304.
12	8071.	4400.	2234.	2638.	13907.	6162.
13	8071.	4133.	1752.	2227.	14390.	6040.
14	8072.	3876.	1233.	1813.	14910.	5938.
15	8072.	3629.	677.	1399.	15468.	5858.
16	8073.	3393.	81.	985.	16065.	5801.
17	8074.	3169.	-556.	570.	16703.	5768.
18	8074.	2959.	-1234.	156.	17382.	5761.
19	8075.	2763.	-1954.	-256.	18104.	5781.
20	8076.	2581.	-2719.	-666.	18870.	5829.

II.63.25

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 413   DESIGN STRESS INTENSITY =   19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	8069.		7028.		10606.	
2	8070.		6640.		10782.	
3	8070.		6250.		10978.	
4	8071.		5858.		11195.	
5	8072.		5464.		11436.	
6	8073.		5067.		11702.	
7	8074.		4668.		11994.	
8	8075.		4267.		12315.	
9	8076.		3863.		12664.	
10	8078.		3457.		13046.	
11	8080.		3049.		13459.	
12	8082.		2638.		13907.	
13	8084.		2227.		14390.	
14	8086.		1813.		14910.	
15	8089.		1399.		15468.	
16	8092.		985.		16065.	
17	8096.		1126.		16703.	
18	8099.		1390.		17382.	
19	8103.		1954.		18104.	
20	8108.		2719.		18870.	

II-C3.26

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11591.	25211.	-68.	-20.	144.
2	11591.	25131.	255.	76.	137.
3	11591.	25037.	562.	168.	130.
4	11591.	24913.	850.	255.	121.
5	11591.	24743.	1119.	336.	112.
6	11591.	24512.	1366.	410.	102.
7	11591.	24207.	1588.	476.	91.
8	11591.	23816.	1781.	534.	77.
9	11591.	23329.	1941.	582.	62.
10	11591.	22737.	2062.	619.	43.
11	11591.	22034.	2138.	641.	22.
12	11591.	21214.	2161.	648.	-3.
13	11591.	20278.	2122.	637.	-32.
14	11591.	19227.	2011.	603.	-66.
15	11591.	18067.	1816.	545.	-105.
16	11591.	16809.	1526.	458.	-149.
17	11591.	15469.	1126.	338.	-200.
18	11591.	14069.	603.	181.	-257.
19	11591.	12636.	-59.	-18.	-320.
20	11591.	11208.	-874.	-262.	-390.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.2792E 00	-0.1491E-01	0.4412E-03
2	0.2782E 00	-0.1468E-01	0.4699E-03
3	0.2770E 00	-0.1444E-01	0.5940E-03
4	0.2754E 00	-0.1421E-01	0.8084E-03
5	0.2732E 00	-0.1397E-01	0.1107E-02
6	0.2702E 00	-0.1373E-01	0.1484E-02
7	0.2663E 00	-0.1349E-01	0.1932E-02
8	0.2613E 00	-0.1323E-01	0.2443E-02
9	0.2551E 00	-0.1298E-01	0.3008E-02
10	0.2474E 00	-0.1271E-01	0.3615E-02
11	0.2384E 00	-0.1243E-01	0.4253E-02
12	0.2279E 00	-0.1214E-01	0.4906E-02
13	0.2159E 00	-0.1183E-01	0.5556E-02
14	0.2023E 00	-0.1150E-01	0.6184E-02
15	0.1874E 00	-0.1116E-01	0.6766E-02
16	0.1713E 00	-0.1080E-01	0.7275E-02
17	0.1541E 00	-0.1041E-01	0.7680E-02
18	0.1361E 00	-0.9998E-02	0.7945E-02
19	0.1177E 00	-0.9563E-02	0.8031E-02
20	0.9932E-01	-0.9104E-02	0.7894E-02

II.6.3.28

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8063.	17538.	7866.	17479.	8261.	17597.
2	8063.	17482.	8804.	17704.	7323.	17260.
3	8063.	17417.	9694.	17906.	6433.	16928.
4	8063.	17331.	10532.	18071.	5595.	16590.
5	8063.	17212.	11312.	18187.	4814.	16237.
6	8063.	17052.	12029.	18241.	4098.	15862.
7	8063.	16840.	12673.	18223.	3454.	15457.
8	8063.	16568.	13234.	18119.	2893.	15017.
9	8063.	16229.	13699.	17920.	2428.	14539.
10	8063.	15817.	14051.	17613.	2076.	14021.
11	8063.	15328.	14272.	17190.	1855.	13465.
12	8063.	14758.	14338.	16640.	1788.	12875.
13	8063.	14106.	14225.	15955.	1902.	12258.
14	8063.	13375.	13902.	15127.	2225.	11623.
15	8063.	12568.	13337.	14150.	2790.	10986.
16	8063.	11693.	12494.	13022.	3633.	10364.
17	8063.	10761.	11333.	11742.	4794.	9780.
18	8063.	9787.	9814.	10312.	6313.	9262.
19	8063.	8790.	7892.	8739.	8234.	8842.
20	8063.	7797.	5525.	7035.	10601.	8558.

I.63.29

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 414 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	17541.		17479.		17597.	
2	17485.		17704.		17260.	
3	17419.		17906.		16928.	
4	17333.		18071.		16590.	
5	17214.		18187.		16237.	
6	17053.		18241.		15862.	
7	16841.		18223.		15457.	
8	16569.		18119.		15017.	
9	16230.		17920.		14539.	
10	15817.		17613.		14021.	
11	15328.		17190.		13465.	
12	14758.		16640.		12875.	
13	14106.		15955.		12258.	
14	13376.		15127.		11623.	
15	12570.		14150.		10986.	
16	11696.		13022.		10364.	
17	10767.		11742.		9780.	
18	9796.		10312.		9262.	
19	8804.		8739.		8842.	
20	8104.		7035.		10601.	

II.6330

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 502

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11591.	26112.	-404.	-121.	-2.
2	11591.	25882.	-396.	-119.	5.
3	11591.	25713.	-366.	-110.	10.
4	11591.	25600.	-321.	-96.	13.
5	11591.	25537.	-267.	-80.	15.
6	11591.	25515.	-208.	-62.	15.
7	11591.	25525.	-148.	-44.	15.
8	11591.	25557.	-89.	-27.	15.
9	11591.	25604.	-32.	-10.	14
10	11591.	25655.	21.	6.	13.
11	11591.	25703.	70.	21.	12
12	11591.	25740.	112.	34.	10.
13	11591.	25761.	147.	44.	[illegible]
14	11591.	25758.	173.	52.	5
15	11591.	25730.	187.	56.	2.
16	11591.	25672.	185.	56.	-3.
17	11591.	25586.	165.	49.	-8.
18	11591.	25475.	119.	36.	-15.
19	11591.	25346.	44.	13.	-24.
20	11591.	25211.	-68.	-20.	-34.

II.6.3.31

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER ..
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 502

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.2908E 00	-0.2208E-01	0.8645E-03
2	0.2879E 00	-0.2171E-01	0.6588E-03
3	0.2857E 00	-0.2134E-01	0.4632E-03
4	0.2842E 00	-0.2096E-01	0.2872E-03
5	0.2834E 00	-0.2058E-01	0.1368E-03
6	0.2831E 00	-0.2020E-01	0.1541E-04
7	0.2833E 00	-0.1982E-01	-0.7548E-04
8	0.2837E 00	-0.1944E-01	-0.1358E-03
9	0.2843E 00	-0.1906E-01	-0.1664E-03
10	0.2849E 00	-0.1869E-01	-0.1690E-03
11	0.2856E 00	-0.1831E-01	-0.1456E-03
12	0.2860E 00	-0.1794E-01	-0.9891E-04
13	0.2863E 00	-0.1756E-01	-0.3237E-04
14	0.2863E 00	-0.1719E-01	0.4985E-04
15	0.2859E 00	-0.1681E-01	0.1424E-03
16	0.2852E 00	-0.1644E-01	0.2383E-03
17	0.2841E 00	-0.1606E-01	0.3287E-03
18	0.2826E 00	-0.1568E-01	0.4025E-03
19	0.2810E 00	-0.1530E-01	0.4457E-03
20	0.2792E 00	-0.1491E-01	0.4412E-03

II.6.3.32

ANALYSIS OF BOTTOM HEAD AND LOWER C..URSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + .P. + S.C. WATER

BODY NO. 502

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8063.	18165.	68[illegible]9.	17813.	9237.	18517.
2	8063.	18005.	69[illegible]3.	17660.	9214.	18350.
3	8063.	17887.	70[illegible]1.	17569.	9126.	18206.
4	8063.	17809.	71[illegible]2.	17530.	8994.	18088.
5	8063.	17765.	72[illegible]9.	17533.	8837.	17997.
6	8063.	17749.	74[illegible]0.	17568.	8661.	17930.
7	8063.	17756.	76[illegible]4.	17628.	8492.	17885.
8	8063.	17779.	78[illegible]6.	17702.	8320.	17856.
9	8063.	17811.	79[illegible]1.	17783.	8156.	17839.
10	8063.	17847.	81[illegible]5.	17865.	8002.	17828.
11	8063.	17880.	82[illegible]5.	17941.	7862.	17820.
12	8063.	17906.	83[illegible]8.	18004.	7738.	17809.
13	8063.	17921.	84[illegible]0.	18049.	7636.	17792.
14	8063.	17919.	85[illegible]5.	18069.	7561.	17768.
15	8063.	17899.	86[illegible]6.	18062.	7521.	17736.
16	8063.	17859.	86[illegible]2.	18020.	7525.	17697.
17	8063.	17799.	85[illegible]2.	17943.	7585.	17656.
18	8063.	17722.	84[illegible]0.	17826.	7716.	17618.
19	8063.	17632.	81[illegible]1.	17670.	7936.	17594.
20	8063.	17538.	78[illegible]6.	17479.	8261.	17597.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 502 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	18165.		17813.		18517.	
2	18005.		17660.		18350.	
3	17887.		17569.		18206.	
4	17809.		17530.		18088.	
5	17765.		17533.		17997.	
6	17749.		17568.		17930.	
7	17756.		17628.		17885.	
8	17779.		17702.		17856.	
9	17811.		17783.		17839.	
10	17847.		17865.		17828.	
11	17880.		17941.		17820.	
12	17906.		18004.		17809.	
13	17921.		18049.		17792.	
14	17919.		18069.		17768.	
15	17899.		18062.		17736.	
16	17859.		18020.		17697.	
17	17799.		17943.		17656.	
18	17722.		17826.		17618.	
19	17632.		17670.		17594.	
20	17538.		17479.		17597.	

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

II-63.34

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 600

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11592.	23140.	-0.	-0.	0.
2	11592.	23255.	-1.	-0.	-0.
3	11592.	23369.	-2.	-1.	-0.
4	11592.	23484.	-5.	-1.	-0.
5	11592.	23601.	-6.	-2.	-0.
6	11592.	23718.	-7.	-2.	-0.
7	11592.	23838.	-6.	-2.	0.
8	11592.	23958.	-3.	-1.	1.
9	11592.	24080.	4.	1.	2.
10	11592.	24200.	15.	5.	3.
11	11592.	24316.	32.	10.	4.
12	11592.	24425.	54.	16.	6.
13	11592.	24522.	82.	25.	7.
14	11592.	24598.	117.	35.	9.
15	11592.	24648.	157.	47.	10.
16	11592.	24661.	201.	60.	10.
17	11592.	24626.	245.	73.	10.
18	11592.	24535.	284.	85.	8.
19	11592.	24377.	313.	94.	5.
20	11592.	24147.	320.	96.	-2.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 600

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.2767E 00	-0.3200E-01	-0.3690E-03
2	0.2783E 00	-0.3145E-01	-0.3692E-03
3	0.2799E 00	-0.3091E-01	-0.3703E-03
4	0.2815E 00	-0.3036E-01	-0.3730E-03
5	0.2831E 00	-0.2982E-01	-0.3771E-03
6	0.2848E 00	-0.2929E-01	-0.3823E-03
7	0.2865E 00	-0.2876E-01	-0.3875E-03
8	0.2882E 00	-0.2823E-01	-0.3910E-03
9	0.2899E 00	-0.2771E-01	-0.3908E-03
10	0.2916E 00	-0.2719E-01	-0.3837E-03
11	0.2932E 00	-0.2668E-01	-0.3663E-03
12	0.2947E 00	-0.2617E-01	-0.3343E-03
13	0.2961E 00	-0.2566E-01	-0.2834E-03
14	0.2972E 00	-0.2516E-01	-0.2085E-03
15	0.2979E 00	-0.2466E-01	-0.1055E-03
16	0.2980E 00	-0.2416E-01	0.2930E-04
17	0.2976E 00	-0.2366E-01	0.1975E-03
18	0.2963E 00	-0.2315E-01	0.3976E-03
19	0.2940E 00	-0.2265E-01	0.6240E-03
20	0.2908E 00	-0.2213E-01	0.8645E-03

II-6.3.36

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 600

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	8832.	17631.	8832.	17631.	8832.	17631.
2	8832.	17718.	8830.	17717.	8835.	17719.
3	8832.	17805.	8824.	17803.	8841.	17808.
4	8832.	17893.	8816.	17888.	8848.	17898.
5	8832.	17981.	8810.	17975.	8854.	17988.
6	8832.	18071.	8807.	18064.	8857.	18079.
7	8832.	18162.	8811.	18155.	8854.	18168.
8	8832.	18254.	8823.	18251.	8842.	18257.
9	8832.	18346.	8847.	18351.	8818.	18342.
10	8832.	18438.	8886.	18454.	8779.	18422.
11	8832.	18527.	8943.	18560.	8722.	18494.
12	8832.	18610.	9020.	18666.	8645.	18553.
13	8832.	18683.	9119.	18769.	8546.	18597.
14	8832.	18742.	9240.	18864.	8425.	18619.
15	8832.	18779.	9379.	18943.	8286.	18615.
16	8832.	18789.	9531.	18999.	8134.	18579.
17	8832.	18763.	9685.	19019.	7980.	18507.
18	8832.	18693.	9823.	18990.	7842.	18396.
19	8832.	18573.	9922.	18900.	7743.	18246.
20	8832.	18397.	9948.	18732.	7717.	18063.

II-6337

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 600   DESIGN STRESS INTENSITY =   19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	17631.		17631.		17631.	
2	17718.		17717.		17719.	
3	17805.		17803.		17808.	
4	17893.		17888.		17898.	
5	17981.		17975.		17988.	
6	18071.		18064.		18079.	
7	18162.		18155.		18168.	
8	18254.		18251.		18257.	
9	18346.		18351.		18342.	
10	18438.		18454.		18422.	
11	18527.		18560.		18494.	
12	18610.		18666.		18553.	
13	18683.		18769.		18597.	
14	18742.		18864.		18619.	
15	18779.		18943.		18615.	
16	18789.		18999.		18579.	
17	18763.		19019.		18507.	
18	18693.		18990.		18396.	
19	18573.		18900.		18246.	
20	18397.		18732.		18063.	

II-6.338

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 500

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-0.	5901.	0.	0.	-0.
2	10.	5891.	0.	0.	-0.
3	19.	5881.	0.	0.	-0.
4	29.	5872.	0.	0.	-0.
5	39.	5862.	0.	0.	-0.
6	48.	5852.	0.	0.	-0.
7	58.	5843.	0.	0.	-0.
8	67.	5833.	0.	0.	-0.
9	77.	5824.	0.	0.	-0.
10	86.	5815.	0.	0.	-0.
11	96.	5805.	0.	0.	-0.
12	105.	5796.	0.	0.	-0.
13	114.	5787.	0.	0.	-0.
14	123.	5777.	0.	0.	-0.
15	133.	5768.	0.	0.	-0.
16	142.	5759.	0.	0.	-0.
17	151.	5750.	0.	0.	-0.
18	160.	5741.	0.	0.	-0.
19	169.	5732.	0.	0.	-0.
20	178.	5723.	0.	0.	-0.

II.6.3.39

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 500

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.2190E-01	0.2817E 00	0.4452E-03
2	0.2153E-01	0.2816E 00	0.4450E-03
3	0.2116E-01	0.2814E 00	0.4448E-03
4	0.2079E-01	0.2813E 00	0.4446E-03
5	0.2043E-01	0.2812E 00	0.4443E-03
6	0.2006E-01	0.2810E 00	0.4441E-03
7	0.1969E-01	0.2809E 00	0.4439E-03
8	0.1932E-01	0.2808E 00	0.4437E-03
9	0.1895E-01	0.2806E 00	0.4435E-03
10	0.1858E-01	0.2805E 00	0.4433E-03
11	0.1821E-01	0.2804E 00	0.4431E-03
12	0.1785E-01	0.2802E 00	0.4429E-03
13	0.1748E-01	0.2801E 00	0.4426E-03
14	0.1711E-01	0.2800E 00	0.4424E-03
15	0.1674E-01	0.2799E 00	0.4422E-03
16	0.1638E-01	0.2797E 00	0.4420E-03
17	0.1601E-01	0.2796E 00	0.4418E-03
18	0.1564E-01	0.2795E 00	0.4416E-03
19	0.1528E-01	0.2794E 00	0.4414E-03
20	0.1491E-01	0.2792E 00	0.4412E-03

II.a3.40

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 500

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-0.	15736.	-0.	15741.	-0.	15731.
2	26.	15710.	26.	15714.	26.	15705.
3	52.	15684.	52.	15688.	52.	15679.
4	78.	15658.	78.	15663.	78.	15653.
5	103.	15632.	103.	15637.	103.	15628.
6	129.	15607.	129.	15611.	129.	15602.
7	154.	15581.	155.	15586.	154.	15577.
8	180.	15556.	180.	15560.	180.	15551.
9	205.	15531.	205.	15535.	205.	15526.
10	230.	15506.	230.	15510.	230.	15501.
11	255.	15481.	255.	15485.	255.	15476.
12	280.	15456.	280.	15460.	280.	15451.
13	305.	15431.	305.	15436.	305.	15426.
14	329.	15406.	329.	15411.	329.	15402.
15	354.	15382.	354.	15386.	354.	15377.
16	378.	15358.	378.	15362.	378.	15353.
17	402.	15333.	402.	15338.	402.	15329.
18	426.	15309.	427.	15314.	426.	15305.
19	450.	15285.	451.	15290.	450.	15281.
20	474.	15261.	474.	15266.	474.	15257.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
VESSEL SUBJECTED TO 1/2 SSE E.Q. + I.P. + S.C. WATER

BODY NO. 500 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	15736.		15741.		15731.	
2	15710.		15714.		15705.	
3	15684.		15688.		15679.	
4	15658.		15663.		15653.	
5	15632.		15637.		15628.	
6	15607.		15611.		15602.	
7	15581.		15586.		15577.	
8	15556.		15560.		15551.	
9	15531.		15535.		15526.	
10	15506.		15510.		15501.	
11	15481.		15485.		15476.	
12	15456.		15460.		15451.	
13	15431.		15436.		15426.	
14	15406.		15411.		15402.	
15	15382.		15386.		15377.	
16	15358.		15362.		15353.	
17	15333.		15338.		15329.	
18	15309.		15314.		15305.	
19	15285.		15290.		15281.	
20	15261.		15266.		15257.	

II.6.3.42

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER

HANFORD NO. 2 CONTAINMENT VESSEL

UNIFORM TEMP. OF 205. F DUE TO LOCA.

BODY LOADS

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BODY NO. 411  BODY TYPE   4  X = MERIDIAN ANGLE
      PN = ( 0.0          ) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
      PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
      T = ( 0.205000E 03 + ( 0.0          )*Z/H)
       + ( 0.0          + ( 0.0          )*Z/H)*X
       + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 412  BODY TYPE   4  X = MERIDIAN ANGLE
      PN = ( 0.0          ) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
      PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
      T = ( 0.205000E 03 + ( 0.0          )*Z/H)
       + ( 0.0          + ( 0.0          )*Z/H)*X
       + ( 0.0          + ( 0.0          )*Z/H)*X*X
BODY NO. 413  BODY TYPE   4  X = MERIDIAN ANGLE
      PN = ( 0.0          ) + ( 0.0          )*COS(X)
       + ( 0.0          )*COS(X)*COS(X)
      PPHI = ( 0.0          )*SIN(X) + ( 0.0          )*SIN(X)*COS(X)
      T = ( 0.205000E 03 + ( 0.0          )*Z/H)
       + ( 0.0          + ( 0.0          )*Z/H)*X
       + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.C.3.43

HANFORD NO. 2 CONTAINMENT VESSEL

UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY LOADS

```
BODY NO. 414  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.0           ) + ( 0.0          )*X
     PPHI = ( 0.0           ) + ( 0.0          )*X
     T = ( 0.205000E 03 + ( 0.0           )*Z/H)
      + ( 0.0           + ( 0.0           )*Z/H)*X
      + ( 0.0           + ( 0.0           )*Z/H)*X*X
BODY NO. 502  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.0           ) + ( 0.0          )*X
     PPHI = ( 0.0           ) + ( 0.0          )*X
     T = ( 0.205000E 03 + ( 0.0           )*Z/H)
      + ( 0.0           + ( 0.0           )*Z/H)*X
      + ( 0.0           + ( 0.0           )*Z/H)*X*X
BODY NO. 600  BODY TYPE   1  X = DISANCE ALONG MERIDIAN FROM 'A' EDGE
     PN = ( 0.0           ) + ( 0.0          )*X
     PPHI = ( 0.0           ) + ( 0.0          )*X
     T = ( 0.205000E 03 + ( 0.0           )*Z/H)
      + ( 0.0           + ( 0.0           )*Z/H)*X
      + ( 0.0           + ( 0.0           )*Z/H)*X*X
```

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.44

HANFORD NO. 2 CONTAINMENT VESSEL

UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY LOADS

BODY NO. 500 BODY TYPE 3. X = RADIUS

```
PN = ( 0.0          ) + ( 0.0          )*X
PPHI = ( 0.0          ) + ( 0.0          )*X
T = ( 0.205000E 03 + ( 0.0          )*Z/H)
  + ( 0.0          + ( 0.0          )*Z/H)*X
  + ( 0.0          + ( 0.0          )*Z/H)*X*X
```

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.45

HANFORD NO. 2 CONTAINMENT VESSEL

UNIFORM TEMP. OF 205. F DUE TO LOCA
CIRCUMFERENTIAL LINE LOADS

NODE	R-DIR.	Z-DIR.	MOMENT
411	0.0	0.0	0.0
412	0.0	0.0	0.0
413	0.0	0.0	0.0
414	0.0	0.0	0.0
500	0.0	0.0	0.0
501	0.0	0.0	0.0
503	0.0	0.0	0.0
600	0.0	0.0	0.0
601	0.0	0.0	0.0

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.46
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

NODE NO.	NODE DISPLACEMENTS R OR R' DIR.	Z OR Z' DIR.	ROTATION	OBLIQUE AXIS ANGLE
411	0.0	0.0	0.0	0.0
412	0.209245E 00	-0.178926E-01	0.206401E-01	0.0
413	0.495102E 00	-0.312545E-01	0.155049E-01	0.0
414	0.659108E 00	-0.176197E-01	0.659768E-02	0.0
500	0.699551E 00	0.401516E-01	-0.847053E-03	0.0
501	0.678639E 00	0.267245E-01	-0.854729E-03	0.0
503	0.686254E 00	0.138333E 00	0.282926E-04	0.0
600	0.686254E 00	0.138335E 00	0.282926E-04	0.0
601	0.686514E 00	0.248724E 00	-0.122344E-05	0.0

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.6.3.47

NODE NO.	REACTION LOADS R OR R' DIR.	Z OR Z' DIR.	MOMENT	OBLIQUE AXIS ANGLE
411	-0.221769E 04	-0.168750E 01	-0.230326E 05	0.0

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.48
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 411

STATION	STRESS RESULTANTS N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	163.	-37027.	-1310.	-447.	-813.
2	175.	-38283.	-1974.	-646.	-869.
3	188.	-39527.	-2683.	-859.	-928.
4	202.	-40755.	-3439.	-1085.	-989.
5	216.	-41963.	-4245.	-1326.	-1051.
6	231.	-43144.	-5100.	-1582.	-1115.
7	247.	-44293.	-6006.	-1852.	-1181.
8	263.	-45406.	-6967.	-2139.	-1249.
9	279.	-46475.	-7980.	-2441.	-1318.
10	296.	-47494.	-9050.	-2760.	-1389.
11	314.	-48458.	-10177.	-3096.	-1462.
12	332.	-49358.	-11361.	-3448.	-1535.
13	351.	-50186.	-12604.	-3818.	-1611.
14	370.	-50937.	-13908.	-4205.	-1687.
15	390.	-51599.	-15272.	-4610.	-1764.
16	410.	-52167.	-16698.	-5033.	-1843.
17	431.	-52629.	-18187.	-5475.	-1922.
18	452.	-52978.	-19738.	-5935.	-2001.
19	473.	-53203.	-21353.	-6413.	-2081.
20	495.	-53293.	-23033.	-6910.	-2162.

II.6.3.49

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 411

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.2087E 00	-0.2309E-01	0.2064E-01
2	0.1925E 00	-0.2211E-01	0.2047E-01
3	0.1764E 00	-0.2111E-01	0.2023E-01
4	0.1605E 00	-0.2007E-01	0.1992E-01
5	0.1449E 00	-0.1900E-01	0.1952E-01
6	0.1296E 00	-0.1790E-01	0.1904E-01
7	0.1148E 00	-0.1677E-01	0.1846E-01
8	0.1004E 00	-0.1561E-01	0.1779E-01
9	0.8667E-01	-0.1443E-01	0.1701E-01
10	0.7355E-01	-0.1321E-01	0.1613E-01
11	0.6116E-01	-0.1197E-01	0.1513E-01
12	0.4962E-01	-0.1071E-01	0.1402E-01
13	0.3901E-01	-0.9427E-02	0.1277E-01
14	0.2943E-01	-0.8122E-02	0.1140E-01
15	0.2099E-01	-0.6799E-02	0.9882E-02
16	0.1380E-01	-0.5460E-02	0.8223E-02
17	0.7985E-02	-0.4107E-02	0.6410E-02
18	0.3660E-02	-0.2745E-02	0.4441E-02
19	0.9556E-03	-0.1375E-02	0.2307E-02
20	-0.5960E-06	0.1304E-06	0.5943E-07

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.50
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 411

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	113.	-25758.	-3692.	-27056.	3918.	-24459.
2	122.	-26631.	-5609.	-28507.	5853.	-24755.
3	131.	-27497.	-7659.	-29990.	7921.	-25004.
4	141.	-28351.	-9845.	-31502.	10126.	-25201.
5	151.	-29192.	-12174.	-33042.	12475.	-25341.
6	161.	-30013.	-14647.	-34606.	14968.	-25420.
7	172.	-30813.	-17268.	-36191.	17612.	-25434.
8	183.	-31587.	-20045.	-37798.	20411.	-25376.
9	194.	-32330.	-22977.	-39419.	23366.	-25242.
10	206.	-33040.	-26070.	-41054.	26483.	-25025.
11	218.	-33710.	-29330.	-42699.	29767.	-24721.
12	231.	-34336.	-32756.	-44348.	33218.	-24324.
13	244.	-34912.	-36352.	-45997.	36840.	-23827.
14	258.	-35434.	-40125.	-47644.	40640.	-23224.
15	271.	-35895.	-44072.	-49282.	44615.	-22509.
16	285.	-36290.	-48198.	-50905.	48769.	-21675.
17	300.	-36612.	-52508.	-52509.	53107.	-20715.
18	314.	-36854.	-56998.	-54086.	57626.	-19622.
19	329.	-37010.	-61672.	-55631.	62330.	-18390.
20	344.	-37074.	-66533.	-57137.	67221.	-17010.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.C.3.51
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 411 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	26664.	*	27056.	*	28377.	*
2	27602.	*	28507.	*	30608.	* *
3	28533.	*	29990.	* *	32925.	* *
4	29456.	* *	31502.	* *	35327.	* *
5	30366.	* *	33042.	* *	37816.	* *
6	31260.	* *	34606.	* *	40389.	* *
7	32134.	* *	36191.	* *	43045.	* *
8	32985.	* *	37798.	* *	45787.	* *
9	33807.	* *	39419.	* *	48608.	* *
10	34596.	* *	41054.	* *	51508.	* *
11	35348.	* *	42699.	* *	54488.	* *
12	36058.	* *	44348.	* *	57542.	* *
13	36719.	* *	45997.	* *	60667.	* * *
14	37328.	* *	47644.	* *	63864.	* * *
15	37877.	* *	49282.	* *	67123.	* * *
16	38360.	* *	50905.	* *	70444.	* * *
17	38772.	* *	52509.	* *	73822.	* * *
18	39105.	* *	56998.	* *	77248.	* * *
19	39353.	* *	61672.	* * *	80720.	* * *
20	39508.	* *	66533.	* * *	84232.	* * *

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.52
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 412

STATION	STRESS RESULTANTS N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	11.	-14856.	4659.	1375.	-85.
2	13.	-15820.	4583.	1351.	-109.
3	16.	-16814.	4488.	1321.	-133.
4	20.	-17837.	4374.	1286.	-160.
5	23.	-18887.	4237.	1244.	-188.
6	27.	-19965.	4078.	1195.	-217.
7	31.	-21069.	3895.	1139.	-249.
8	36.	-22199.	3687.	1076.	-282.
9	40.	-23352.	3452.	1004.	-316.
10	45.	-24527.	3188.	924.	-353.
11	51.	-25723.	2896.	835.	-391.
12	57.	-26938.	2572.	737.	-431.
13	63.	-28169.	2216.	630.	-473.
14	69.	-29416.	1826.	512.	-517.
15	76.	-30673.	1401.	384.	-563.
16	83.	-31940.	939.	244.	-610.
17	91.	-33214.	438.	94.	-660.
18	99.	-34491.	-102.	-69.	-711.
19	108.	-35767.	-685.	-244.	-765.
20	117.	-37041.	-1310.	-432.	-820.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.53
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 412

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.4955E 00	-0.2399E-01	0.1551E-01
2	0.4831E 00	-0.2360E-01	0.1599E-01
3	0.4702E 00	-0.2318E-01	0.1646E-01
4	0.4570E 00	-0.2273E-01	0.1692E-01
5	0.4435E 00	-0.2226E-01	0.1737E-01
6	0.4295E 00	-0.2175E-01	0.1780E-01
7	0.4153E 00	-0.2123E-01	0.1822E-01
8	0.4007E 00	-0.2067E-01	0.1861E-01
9	0.3859E 00	-0.2008E-01	0.1899E-01
10	0.3707E 00	-0.1946E-01	0.1933E-01
11	0.3553E 00	-0.1882E-01	0.1965E-01
12	0.3397E 00	-0.1814E-01	0.1993E-01
13	0.3238E 00	-0.1743E-01	0.2018E-01
14	0.3078E 00	-0.1669E-01	0.2040E-01
15	0.2916E 00	-0.1591E-01	0.2057E-01
16	0.2753E 00	-0.1511E-01	0.2069E-01
17	0.2589E 00	-0.1427E-01	0.2076E-01
18	0.2425E 00	-0.1340E-01	0.2078E-01
19	0.2261E 00	-0.1250E-01	0.2074E-01
20	0.2097E 00	-0.1156E-01	0.2064E-01

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.63.54
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 412

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	7.	-10334.	13535.	-6343.	-13520.	-14325.
2	9.	-11005.	13317.	-7083.	-13298.	-14927.
3	11.	-11697.	13044.	-7860.	-13021.	-15533.
4	14.	-12408.	12713.	-8675.	-12685.	-16142.
5	16.	-13139.	12319.	-9528.	-12287.	-16751.
6	19.	-13889.	11860.	-10419.	-11823.	-17359.
7	22.	-14657.	11332.	-11349.	-11288.	-17965.
8	25.	-15443.	10729.	-12320.	-10680.	-18566.
9	28.	-16245.	10050.	-13330.	-9994.	-19160.
10	32.	-17063.	9290.	-14379.	-9226.	-19746.
11	35.	-17894.	8444.	-15469.	-8373.	-20320.
12	39.	-18739.	7508.	-16598.	-7429.	-20880.
13	44.	-19596.	6479.	-17767.	-6392.	-21424.
14	48.	-20463.	5351.	-18977.	-5254.	-21950.
15	53.	-21338.	4121.	-20224.	-4015.	-22452.
16	58.	-22219.	2784.	-21510.	-2668.	-22929.
17	63.	-23105.	1336.	-22834.	-1209.	-23377.
18	69.	-23993.	-228.	-24194.	367.	-23793.
19	75.	-24881.	-1913.	-25590.	2063.	-24173.
20	81.	-25767.	-3723.	-27021.	3885.	-24513.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER   II.6.3.55
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 412   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	10427.		19878.	*	14325.	
2	11123.		20400.	*	14927.	
3	11842.		20904.	*	15533.	
4	12582.		21387.	*	16142.	
5	13343.		21847.	*	16751.	
6	14125.		22279.	*	17359.	
7	14927.		22681.	*	17965.	
8	15749.		23049.	*	18566.	
9	16589.		23380.	*	19160.	
10	17447.		23669.	*	19746.	*
11	18320.		23912.	*	20320.	*
12	19209.		24106.	*	20880.	*
13	20112.	*	24246.	*	21424.	*
14	21027.	*	24327.	*	21950.	*
15	21952.	*	24345.	*	22452.	*
16	22886.	*	24294.	*	22929.	*
17	23826.	*	24169.	*	23377.	*
18	24771.	*	24194.	*	24160.	*
19	25718.	*	25590.	*	26236.	*
20	26665.	*	27021.	*	28399.	*

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.56
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 413

STATION	STRESS RESULTANTS N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-3.	-2142.	3818.	1143.	136.
2	-3.	-2559.	3924.	1175.	132.
3	-3.	-3001.	4027.	1205.	128.
4	-3.	-3469.	4126.	1235.	123.
5	-3.	-3963.	4221.	1263.	117.
6	-3.	-4485.	4312.	1289.	111.
7	-3.	-5033.	4397.	1314.	104.
8	-3.	-5610.	4475.	1338.	96.
9	-3.	-6216.	4547.	1359.	86.
10	-3.	-6850.	4612.	1378.	76.
11	-2.	-7514.	4668.	1394.	65.
12	-2.	-8209.	4716.	1408.	53.
13	-1.	-8932.	4753.	1418.	40.
14	-1.	-9687.	4779.	1426.	26.
15	0.	-10472.	4794.	1430.	11.
16	1.	-11288.	4797.	1430.	-6.
17	2.	-12134.	4785.	1426.	-24.
18	3.	-13012.	4759.	1417.	-43.
19	4.	-13919.	4718.	1404.	-64.
20	5.	-14857.	4659.	1386.	-86.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.C.3.57
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 413

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.6593E 00	-0.4296E-03	0.6598E-02
2	0.6540E 00	-0.3696E-03	0.7000E-02
3	0.6483E 00	-0.2987E-03	0.7413E-02
4	0.6423E 00	-0.2161E-03	0.7837E-02
5	0.6359E 00	-0.1212E-03	0.8271E-02
6	0.6292E 00	-0.1335E-04	0.8715E-02
7	0.6222E 00	0.1081E-03	0.9167E-02
8	0.6148E 00	0.2441E-03	0.9629E-02
9	0.6070E 00	0.3951E-03	0.1010E-01
10	0.5989E 00	0.5620E-03	0.1057E-01
11	0.5903E 00	0.7454E-03	0.1106E-01
12	0.5814E 00	0.9463E-03	0.1154E-01
13	0.5721E 00	0.1165E-02	0.1204E-01
14	0.5624E 00	0.1403E-02	0.1253E-01
15	0.5524E 00	0.1661E-02	0.1303E-01
16	0.5419E 00	0.1939E-02	0.1353E-01
17	0.5310E 00	0.2238E-02	0.1403E-01
18	0.5198E 00	0.2559E-02	0.1452E-01
19	0.5081E 00	0.2903E-02	0.1502E-01
20	0.4961E 00	0.3271E-02	0.1550E-01

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.6.3.58

BODY NO. 413

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-2.	-1490.	11085.	1829.	-11089.	-4809.
2	-2.	-1780.	11392.	1630.	-11397.	-5190.
3	-2.	-2088.	11691.	1412.	-11695.	-5587.
4	-2.	-2413.	11979.	1171.	-11983.	-5998.
5	-2.	-2757.	12255.	909.	-12259.	-6423.
6	-2.	-3120.	12517.	624.	-12522.	-6864.
7	-2.	-3501.	12763.	315.	-12768.	-7318.
8	-2.	-3903.	12992.	-19.	-12997.	-7787.
9	-2.	-4324.	13202.	-378.	-13206.	-8269.
10	-2.	-4766.	13390.	-765.	-13393.	-8766.
11	-2.	-5227.	13553.	-1179.	-13556.	-9275.
12	-1.	-5710.	13691.	-1623.	-13693.	-9798.
13	-1.	-6214.	13800.	-2095.	-13801.	-10333.
14	-0.	-6739.	13877.	-2599.	-13878.	-10879.
15	0.	-7285.	13921.	-3133.	-13921.	-11436.
16	1.	-7853.	13928.	-3701.	-13927.	-12004.
17	1.	-8441.	13896.	-4301.	-13893.	-12581.
18	2.	-9052.	13821.	-4936.	-13817.	-13167.
19	3.	-9683.	13701.	-5606.	-13695.	-13760.
20	4.	-10335.	13532.	-6311.	-13524.	-14360.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.59
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 413 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	1631.		11085.		11089.	
2	1917.		11392.		11397.	
3	2220.		11691.		11695.	
4	2540.		11979.		11983.	
5	2878.		12255.		12259.	
6	3234.		12517.		12522.	
7	3608.		12763.		12768.	
8	4001.		13011.		12997.	
9	4413.		13580.		13206.	
10	4844.		14155.		13393.	
11	5295.		14733.		13556.	
12	5765.		15313.		13693.	
13	6256.		15895.		13801.	
14	6766.		16476.		13878.	
15	7296.		17054.		13921.	
16	7859.		17629.		13927.	
17	8467.		18197.		13893.	
18	9098.		18757.		13817.	
19	9751.		19306.	*	13760.	
20	10427.		19843.	*	14360.	

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.60
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 414

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	0.	1007.	-169.	-51.	21.
2	0.	1163.	-115.	-35.	26.
3	0.	1325.	-50.	-15.	31.
4	0.	1489.	30.	9.	38.
5	0.	1652.	125.	37.	45.
6	0.	1808.	236.	71.	52.
7	0.	1951.	366.	110.	61.
8	0.	2075.	516.	155.	70.
9	0.	2170.	688.	206.	79.
10	0.	2227.	881.	264.	89.
11	0.	2237.	1098.	329.	99.
12	0.	2187.	1337.	401.	109.
13	0.	2065.	1599.	480.	119.
14	0.	1856.	1882.	565.	127.
15	0.	1544.	2184.	655.	135.
16	0.	1114.	2501.	750.	141.
17	0.	549.	2830.	849.	145.
18	0.	-170.	3164.	949.	146.
19	0.	-1061.	3497.	1049.	143.
20	0.	-2141.	3818.	1146.	136.

II.C.3.Ci

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 414

STATION	DISPLACEMENTS NORMAL	DISPLACEMENTS TANGENTIAL	ROTATION
1	0.6996E 00	-0.4015E-01	-0.8470E-03
2	0.7016E 00	-0.3711E-01	-0.8904E-03
3	0.7036E 00	-0.3406E-01	-0.9157E-03
4	0.7057E 00	-0.3102E-01	-0.9191E-03
5	0.7078E 00	-0.2799E-01	-0.8961E-03
6	0.7098E 00	-0.2495E-01	-0.8419E-03
7	0.7117E 00	-0.2192E-01	-0.7512E-03
8	0.7133E 00	-0.1889E-01	-0.6180E-03
9	0.7145E 00	-0.1587E-01	-0.4361E-03
10	0.7152E 00	-0.1284E-01	-0.1989E-03
11	0.7154E 00	-0.9814E-02	0.1003E-03
12	0.7147E 00	-0.6788E-02	0.4686E-03
13	0.7131E 00	-0.3761E-02	0.9129E-03
14	0.7105E 00	-0.7307E-03	0.1440E-02
15	0.7065E 00	0.2304E-02	0.2055E-02
16	0.7009E 00	0.5345E-02	0.2764E-02
17	0.6937E 00	0.8394E-02	0.3572E-02
18	0.6844E 00	0.1145E-01	0.4480E-02
19	0.6730E 00	0.1453E-01	0.5489E-02
20	0.6591E 00	0.1762E-01	0.6598E-02

II-6.3-62

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 414

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	0.	701.	-491.	553.	491.	848.
2	0.	809.	-335.	708.	335.	909.
3	0.	922.	-144.	878.	144.	965.
4	0.	1036.	87.	1062.	-87.	1010.
5	0.	1149.	362.	1258.	-361.	1041.
6	0.	1258.	686.	1464.	-685.	1052.
7	0.	1357.	1064.	1676.	-1063.	1038.
8	0.	1443.	1500.	1893.	-1499.	993.
9	0.	1509.	1997.	2108.	-1997.	910.
10	0.	1549.	2559.	2317.	-2559.	782.
11	0.	1556.	3188.	2513.	-3188.	600.
12	0.	1522.	3883.	2686.	-3883.	357.
13	0.	1436.	4643.	2829.	-4643.	44.
14	0.	1291.	5464.	2930.	-5464.	-348.
15	0.	1074.	6341.	2976.	-6340.	-828.
16	0.	775.	7263.	2954.	-7262.	-1403.
17	0.	382.	8217.	2847.	-8217.	-2083.
18	0.	-118.	9188.	2638.	-9188.	-2875.
19	0.	-738.	10154.	2308.	-10154.	-3784.
20	0.	-1489.	11087.	1837.	-11087.	-4815.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.63
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 414 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE		OUTSIDE SURFACE		INSIDE SURFACE	
	SI	T1T2T3	SI	T1T2T3	SI	T1T2T3
1	723.		1044.		848.	
2	836.		1043.		909.	
3	954.		1022.		965.	
4	1075.		1062.		1097.	
5	1196.		1258.		1402.	
6	1313.		1464.		1738.	
7	1421.		1676.		2102.	
8	1516.		1893.		2493.	
9	1592.		2108.		2907.	
10	1642.		2559.		3341.	
11	1660.		3188.		3788.	
12	1635.		3883.		4240.	
13	1560.		4643.		4686.	
14	1424.		5464.		5464.	
15	1215.		6341.		6340.	
16	922.		7263.		7262.	
17	533.		8217.		8217.	
18	304.		9188.		9188.	
19	887.		10154.		10154.	
20	1631.		11087.		11087.	

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.6.3.64

BODY NO. 502

STATION	STRESS RESULTANTS N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-0.	-28.	8.	2.	0.
2	-0.	-37.	8.	2.	-0.
3	-0.	-47.	7.	2.	-1.
4	-0.	-59.	4.	1.	-1.
5	-0.	-71.	-1.	-0.	-1.
6	-0.	-83.	-7.	-2.	-2.
7	-0.	-93.	-16.	-5.	-3.
8	-0.	-101.	-28.	-8.	-3.
9	-0.	-105.	-43.	-13.	-4.
10	-0.	-102.	-60.	-18.	-5.
11	-0.	-90.	-81.	-24.	-6.
12	-0.	-65.	-104.	-31.	-6.
13	-0.	-24.	-130.	-39.	-7.
14	-0.	37.	-155.	-47.	-7.
15	-0.	122.	-180.	-54.	-6.
16	-0.	235.	-201.	-60.	-5.
17	-0.	378.	-215.	-65.	-2.
18	-0.	555.	-218.	-65.	1.
19	-0.	765.	-205.	-61.	6.
20	-0.	1007.	-169.	-51.	13.

II.6.3.65

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 502

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.6863E 00	-0.1383E 00	0.2829E-04
2	0.6861E 00	-0.1332E 00	0.3250E-04
3	0.6860E 00	-0.1280E 00	0.3628E-04
4	0.6859E 00	-0.1228E 00	0.3899E-04
5	0.6857E 00	-0.1176E 00	0.3986E-04
6	0.6855E 00	-0.1125E 00	0.3788E-04
7	0.6854E 00	-0.1073E 00	0.3195E-04
8	0.6853E 00	-0.1021E 00	0.2071E-04
9	0.6853E 00	-0.9696E-01	0.2750E-05
10	0.6853E 00	-0.9178E-01	-0.2350E-04
11	0.6855E 00	-0.8661E-01	-0.5959E-04
12	0.6858E 00	-0.8144E-01	-0.1069E-03
13	0.6863E 00	-0.7627E-01	-0.1667E-03
14	0.6871E 00	-0.7110E-01	-0.2396E-03
15	0.6882E 00	-0.6593E-01	-0.3254E-03
16	0.6896E 00	-0.6076E-01	-0.4231E-03
17	0.6915E 00	-0.5560E-01	-0.5299E-03
18	0.6937E 00	-0.5045E-01	-0.6413E-03
19	0.6964E 00	-0.4530E-01	-0.7503E-03
20	0.6996E 00	-0.4015E-01	-0.8471E-03

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.6.
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 502

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-0.	-19.	24.	-12.	-24.	-27.
2	-0.	-26.	23.	-19.	-23.	-33.
3	-0.	-33.	19.	-27.	-19.	-39.
4	-0.	-41.	11.	-38.	-11.	-44.
5	-0.	-49.	-2.	-50.	2.	-49.
6	-0.	-57.	-21.	-64.	21.	-51.
7	-0.	-65.	-47.	-79.	47.	-51.
8	-0.	-71.	-81.	-95.	81.	-46.
9	-0.	-73.	-124.	-110.	124.	-36.
10	-0.	-71.	-176.	-124.	176.	-18.
11	-0.	-63.	-236.	-133.	236.	8.
12	-0.	-45.	-303.	-136.	303.	46.
13	-0.	-17.	-376.	-130.	376.	96.
14	-0.	26.	-451.	-110.	451.	161.
15	-0.	85.	-523.	-72.	523.	242.
16	-0.	163.	-584.	-12.	584.	338.
17	-0.	263.	-625.	76.	625.	451.
18	-0.	386.	-634.	196.	634.	576.
19	-0.	533.	-595.	354.	595.	711.
20	-0.	701.	-491.	553.	491.	848.

II.6.3.67

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 502   DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	19.		36.		27.	
2	26.		42.		33.	
3	34.		46.		39.	
4	42.		49.		44.	
5	51.		50.		51.	
6	60.		64.		72.	
7	68.		79.		98.	
8	74.		95.		128.	
9	78.		124.		160.	
10	76.		176.		194.	
11	69.		236.		236.	
12	52.		303.		303.	
13	24.		376.		376.	
14	33.		451.		451.	
15	91.		523.		523.	
16	168.		584.		584.	
17	266.		701.		625.	
18	387.		830.		634.	
19	539.		949.		711.	
20	714.		1044.		848.	

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.6.3.68

BODY NO. 600

STATION	STRESS RESULTANTS N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-0.	-1.	-0.	-0.	-0.
2	-0.	-1.	-0.	-0.	-0.
3	-0.	-0.	-0.	-0.	-0.
4	-0.	0.	-0.	-0.	-0.
5	-0.	1.	-0.	-0.	-0.
6	-0.	1.	-0.	-0.	-0.
7	-0.	2.	-0.	-0.	0.
8	-0.	2.	-0.	-0.	0.
9	-0.	3.	0.	0.	0.
10	-0.	3.	0.	0.	0.
11	-0.	4.	1.	0.	0.
12	-0.	4.	1.	0.	0.
13	-0.	4.	2.	1.	0.
14	-0.	4.	3.	1.	0.
15	-0.	3.	4.	1.	0.
16	-0.	1.	5.	1.	0.
17	-0.	-1.	6.	2.	0.
18	-0.	-6.	7.	2.	0.
19	-0.	-12.	8.	2.	0.
20	-0.	-20.	8.	3.	0.

II.6.3.69

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 600

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.6865E 00	-0.2487E 00	-0.1223E-05
2	0.6865E 00	-0.2429E 00	-0.1250E-05
3	0.6865E 00	-0.2371E 00	-0.1297E-05
4	0.6865E 00	-0.2313E 00	-0.1374E-05
5	0.6865E 00	-0.2255E 00	-0.1502E-05
6	0.6865E 00	-0.2197E 00	-0.1658E-05
7	0.6866E 00	-0.2139E 00	-0.1822E-05
8	0.6866E 00	-0.2081E 00	-0.1954E-05
9	0.6866E 00	-0.2022E 00	-0.2009E-05
10	0.6866E 00	-0.1964E 00	-0.1914E-05
11	0.6866E 00	-0.1906E 00	-0.1585E-05
12	0.6866E 00	-0.1848E 00	-0.9152E-06
13	0.6866E 00	-0.1790E 00	0.1993E-06
14	0.6866E 00	-0.1732E 00	0.1893E-05
15	0.6866E 00	-0.1674E 00	0.4283E-05
16	0.6865E 00	-0.1616E 00	0.7471E-05
17	0.6865E 00	-0.1558E 00	0.1152E-04
18	0.6864E 00	-0.1500E 00	0.1643E-04
19	0.6864E 00	-0.1441E 00	0.2211E-04
20	0.6863E 00	-0.1383E 00	0.2829E-04

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.6.3.70

BODY NO. 600

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-0.	-1.	-0.	-1.	0.	-1.
2	-0.	-1.	-0.	-1.	0.	-0.
3	-0.	-0.	-0.	-0.	0.	-0.
4	-0.	0.	-1.	-0.	0.	0.
5	-0.	0.	-1.	0.	1.	1.
6	-0.	1.	-1.	1.	1.	1.
7	-0.	1.	-1.	1.	1.	1.
8	-0.	2.	-0.	1.	0.	2.
9	-0.	2.	0.	2.	-0.	2.
10	-0.	3.	1.	3.	-1.	2.
11	-0.	3.	2.	4.	-2.	2.
12	-0.	3.	4.	5.	-4.	2.
13	-0.	3.	6.	5.	-6.	1.
14	-0.	3.	9.	6.	-9.	0.
15	-0.	2.	13.	6.	-13.	-1.
16	-0.	1.	17.	6.	-17.	-4.
17	-0.	-1.	21.	5.	-21.	-7.
18	-0.	-4.	24.	3.	-25.	-12.
19	-0.	-9.	28.	-1.	-28.	-17.
20	-0.	-15.	29.	-6.	-29.	-24.

PITTSBURGH-DES MOINES STEEL COMPANY AXISYMMETRIC SHELL PROGRAM AX2

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.71.
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 600 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	1.		1.		1.	
2	1.		1.		1.	
3	0.		0.		0.	
4	0.		1.		0.	
5	0.		1.		1.	
6	1.		1.		1.	
7	1.		2.		1.	
8	2.		2.		2.	
9	2.		2.		2.	
10	3.		3.		3.	
11	3.		4.		5.	
12	3.		5.		6.	
13	4.		6.		8.	
14	3.		9.		10.	
15	3.		13.		13.	
16	1.		17.		17.	
17	1.		21.		21.	
18	5.		24.		25.	
19	9.		28.		28.	
20	15.		35.		29.	

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.C.3.72

BODY NO. 500

STATION	STRESS RESULTANTS				
	N-PHI	N-THETA	M-PHI	M-THETA	Q-PHI
1	-0.	273.	-0.	-0.	0.
2	0.	273.	-0.	-0.	0.
3	1.	273.	-0.	-0.	0.
4	1.	272.	-0.	-0.	0.
5	2.	272.	-0.	-0.	0.
6	2.	271.	-0.	-0.	0.
7	3.	271.	-0.	-0.	0.
8	3.	270.	-0.	-0.	0.
9	3.	270.	-0.	-0.	0.
10	4.	269.	-0.	-0.	0.
11	4.	269.	-0.	-0.	0.
12	5.	269.	-0.	-0.	0.
13	5.	268.	-0.	-0.	0.
14	6.	268.	-0.	-0.	0.
15	6.	267.	-0.	-0.	0.
16	7.	267.	-0.	-0.	0.
17	7.	266.	-0.	-0.	0.
18	7.	266.	-0.	-0.	0.
19	8.	266.	-0.	-0.	0.
20	8.	265.	-0.	-0.	0.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER II.6.3.73
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

BODY NO. 500

STATION	DISPLACEMENTS NORMAL	TANGENTIAL	ROTATION
1	0.2672E-01	0.6786E 00	-0.8547E-03
2	0.2743E-01	0.6797E 00	-0.8543E-03
3	0.2814E-01	0.6808E 00	-0.8539E-03
4	0.2885E-01	0.6819E 00	-0.8535E-03
5	0.2956E-01	0.6830E 00	-0.8530E-03
6	0.3027E-01	0.6841E 00	-0.8526E-03
7	0.3098E-01	0.6852E 00	-0.8522E-03
8	0.3169E-01	0.6863E 00	-0.8518E-03
9	0.3239E-01	0.6874E 00	-0.8514E-03
10	0.3310E-01	0.6885E 00	-0.8510E-03
11	0.3381E-01	0.6896E 00	-0.8506E-03
12	0.3451E-01	0.6907E 00	-0.8502E-03
13	0.3522E-01	0.6918E 00	-0.8498E-03
14	0.3592E-01	0.6929E 00	-0.8494E-03
15	0.3663E-01	0.6940E 00	-0.8490E-03
16	0.3733E-01	0.6951E 00	-0.8486E-03
17	0.3804E-01	0.6962E 00	-0.8482E-03
18	0.3874E-01	0.6973E 00	-0.8478E-03
19	0.3945E-01	0.6985E 00	-0.8474E-03
20	0.4015E-01	0.6996E 00	-0.8471E-03

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.6.3.74

BODY NO. 500

STATION	MEMBRANE STRESSES		MEMBRANE + BENDING ON EXTREME FIBERS			
			OUTSIDE FIBERS		INSIDE FIBERS	
	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA	SIG-PHI	SIG-THETA
1	-0.	729.	-0.	720.	-0.	738.
2	1.	728.	1.	719.	1.	737.
3	2.	727.	2.	718.	2.	736.
4	3.	726.	3.	717.	3.	734.
5	5.	724.	5.	715.	5.	733.
6	6.	723.	6.	714.	6.	732.
7	7.	722.	7.	713.	7.	731.
8	8.	721.	8.	712.	8.	730.
9	9.	720.	9.	711.	9.	728.
10	10.	718.	10.	710.	11.	727.
11	12.	717.	12.	709.	12.	726.
12	13.	716.	13.	707.	13.	725.
13	14.	715.	14.	706.	14.	724.
14	15.	714.	15.	705.	15.	723.
15	16.	713.	16.	704.	16.	721.
16	17.	712.	17.	703.	17.	720.
17	18.	710.	18.	702.	19.	719.
18	20.	709.	19.	701.	20.	718.
19	21.	708.	21.	700.	21.	717.
20	22.	707.	22.	698.	22.	716.

ANALYSIS OF BOTTOM HEAD AND LOWER COURSE OF CYLINDER
HANFORD NO. 2 CONTAINMENT VESSEL
UNIFORM TEMP. OF 205. F DUE TO LOCA

II.6.3.75

BODY NO. 500 DESIGN STRESS INTENSITY = 19300.

STATION	MID-SURFACE SI	MID-SURFACE T1T2T3	OUTSIDE SURFACE SI	OUTSIDE SURFACE T1T2T3	INSIDE SURFACE SI	INSIDE SURFACE T1T2T3
1	729.		720.		738.	
2	728.		719.		737.	
3	727.		718.		736.	
4	726.		717.		734.	
5	724.		715.		733.	
6	723.		714.		732.	
7	722.		713.		731.	
8	721.		712.		730.	
9	720.		711.		728.	
10	718.		710.		727.	
11	717.		709.		726.	
12	716.		707.		725.	
13	715.		706.		724.	
14	714.		705.		723.	
15	713.		704.		721.	
16	712.		703.		720.	
17	710.		702.		719.	
18	709.		701.		718.	
19	708.		700.		717.	
20	707.		698.		716.	

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ANALYSIS OF THERMAL + PRESSURE DISCONTINUITY STRESSES

AS CAN BE SEEN FROM THE A42 OUTPUT (PAGES II.6.3.16 AND II.6.3.50) THE DISCONTINUITY STRESSES AT THE BOTTOM OF BODY 411 (VICINITY AT THE TOP OF THE INSIDE CONCRETE) ARE $\sigma_\phi = 67{,}221^{TH.} + 1489^{PR.}$ & $\sigma_\theta = -17{,}010^{TH} + 447^{PR}$, OR SI = 85,273 psi, WHICH IS > $3S_M$ (51900 PSI). THE ELASTO-PLASTIC ANALYSIS OF PARA. NB-3228.3 OF REFERENCE 2 WILL BE USED TO SHOW THAT THESE STRESSES ARE ALLOWED FOR PEAK STRESSES.

CONDITION (a) PRIMARY + BENDING MAXIMUM SI (EXCLUDING THERMAL BENDING EFFECTS) = 47,746 psi (BODY 411, PRESSURE LOADING + THERMAL MEMBRANE) ≤ $3S_M$ ✓
$\sqrt{}$ 76.9 KSI

CONDITION (b)

S_n = RANGE OF PRIMARY + SECONDARY STRESS INTENSITY
= 85,273. > $3S_m$

$3S_m < S_n < 3mS_m$ WHERE m = 3.0 FOR CARBON STEEL

$$K_e = 1.0 + \frac{(1-n)}{n(m-1)}\left(\frac{S_n}{3S_m} - 1\right)$$ n = .2 FOR CARBON STEEL

$K_e = 1.946$

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Salt = ½ Ke Sp

ORIGINAL VALUE OF SA = 0.5 * 85,273.* = 42,637. psi
REVISED S_A = 1.946 * 42637. = 82,972. psi
INCREASING THIS VALUE BY THE RATIO OF E curve TO E MAT'L GIVES VALUE WITH WHICH TO ENTER FATIGUE CURVES OF:

$$S_A = 82{,}972 * \frac{30.}{27.9} = 89{,}217.\ psi$$

FROM FIGURE I-9-1 OF REFERENCE 2, USING SA516-GR70 MATERIAL WITH AN ULTIMATE STRENGTH OF 70ksi, THE ALLOWED NUMBER OF CYCLES IS 800 > 10 ASSUMED FOR LOCA CONDITION
∴ THIS CRITERIA SATISFIED.

CONDITION (d)

THERMAL RATCHETING IS NOT APPLICABLE SINCE A GRADIENT DOES NOT EXIST ACROSS THE SHELL THICKNESS.

CONDITION (e)

MAX. TEMPERATURE = 275°F < 700°F ∴ OK

CONDITION (f)

$F_Y / F_{ULT} = 38/70 = 0.543 < 0.8$ ∴ OK

CONDITION (c)

THE SATISFACTION OF NB-3222.4(d) SHALL BE AS FOLLOWS:

(1.) ATMOSPHERIC TO OPERATING PRESSURE CYCLES:
S_M = 19.3 ksi
$S_A = 3S_M = 57.9 * \frac{30}{27.9} = 62.258$ ksi
FROM FIG. I-9-1:
ALL. # CYCLES = 2000 > 100 CYCLES SPECIFIED IN REFERENCE 1
∴ OK

*SALT AS DEFINED IN PARAGRAPH NB 3216.1 OF REF. 2

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(2) NORMAL OPERATION PRESSURE FLUCTUATIONS:

$$SIG.\ PRES.\ FLUCT. = I.P. * \frac{1}{3} * \frac{S}{S_M}$$

W/ $S = S_A$ FOR 10^6 CYCLES = 12,500 psi ✓

∴ SIG. PRES. FLUCT. = 9.72 psi ✓

FOR NORMAL OPERATION, PRESSURE FLUCTUATES FROM −2 psi TO +2 psi, OR 4 psi. ∴ THERE ARE NO SIGNIFICANT PRESSURE FLUCTUATIONS. ✓

(3), (4), & (5) TEMPERATURE DIFFERENCE:

SINCE THE TEMPERATURE DIFFERENCE BETWEEN ANY TWO ADJACENT POINTS ARE NEGLIGIBLE, THESE CONDITIONS ARE SATISFIED. ✓

(6) MECHANICAL LOADS:

MECHANICAL LOADINGS ARE NOT APPLICABLE IN THE BOTTOM HEAD. ✓

PARAGRAPH NB-3222.4(d) HAS THUS BEEN SATISFIED, AND THE BOTTOM HEAD UNDER THERMAL LOADINGS IS ADEQUATE ✓

INNER SKIRT DESIGN:

IN ADDITION TO THE AX-2 ANALYSIS OF ARTICLE 2, THE INNER SKIRT* WILL BE DESIGNED USING A BEAM-TENSION, CONCRETE COMPRESSION APPROACH AS PRESENTED IN REFERENCE 21. LOADINGS FROM DRAWING S794 OF REFERENCE 1 WILL BE APPLIED SO AS TO GIVE THE HIGHEST POSSIBLE TENSILE STRESS IN THE SKIRT (COMPRESSIVE STRESSES IN THE SKIRT WERE NOT CONSIDERED AS THE SKIRT WILL BE BURIED IN CONCRETE PRIOR TO ANY LOAD APPLICATION) SINCE THE PIPE RUPTURE AND JET FORCE LOADINGS WILL NOT OCCUR SIMULTANEOUSLY, THE HIGHER P LOAD AND Mc LOADING WILL BE USED FOR EACH LOADING CASE. FOR THE SSE CONDITION, AN ALLOWABLE OF 0.91Fy WILL BE USED. (FROM REFERENCE 1 FOR AISC DESIGN) FOR ½SSE, AN Sm VALUE WILL BE USED (ASME ALLOWABLE IS LESS THAN AISC ALLOWABLE)

FOR VERTICAL P LOADS UP BEING NEGATIVE, THE FOLLOWING LOADS MUST BE APPLIED TO THE SKIRT DESIGN:

	P	Mc
GRAVITY LOAD	= +19,100. kips ✓	—
GRAV. – FLOOD	= +16,600. kips ✓	—
½SSE	= ±4580. kips	±160,000 FT-kips ✓
SSE	= ±9160. kips ✓	±270,000 FT-kips ✓
FLOOD ½SSE	= ±4500. kips ✓	±270,000 FT-kips ✓
PIPE RUPTURE	= ± 840. kips ✓	± 1500 FT-kips ✓
JET FORCE	= ±534. kips ✓	± 2260 FT-kips. ✓
DIFF. PRESS.	= +4590. kips	

REF. B: REL: S-794

FOR DESIGN CONDITIONS, CONSIDER

1. NORMAL ALLOW:

P = GRAV. LOAD — ½SSE — PIPE RUPTURE
Mc = ½SSE + JET FORCE

*AND CORRESPONDING SEISMIC ANCHORAGE RING.

2. 0.9 FY ALLOW:

P = GRAV. LOAD − SSE − PIPE RUPTURE
M_S = SSE + JET FORCE

∴ FOR NORMAL CONDITIONS,

P = 19100 − 4580 − 840 = 13680 kips
M_L = (169,000 + 2260)(12) = 1,947,120 IN kips

FOR 0.9 FY CONDITION,

P = 19100 − 9160 − 840 = 9100 kips
M_S = (270,000 + 2260)(12) = 3,267,120 IN kips

USING REFERENCE 21, CHAPTER 10, THE FOLLOWING GEOMETRY EXISTS:

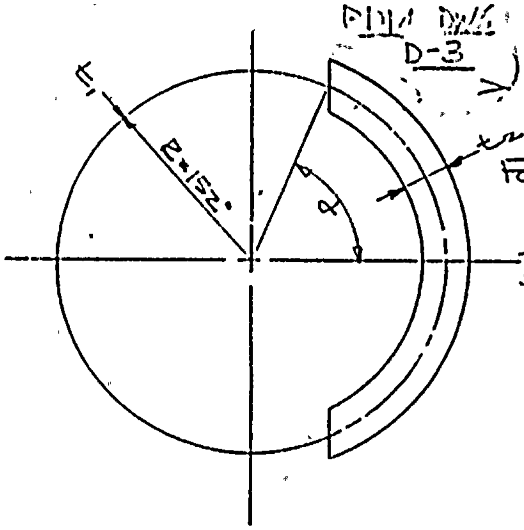

FIG. DWG. D-3 AN ANALYSIS WILL BE PERFORMED ON THE GEOMETRY OF FIGURE II.6.2, WHERE t_1 = 15/16, AND t_2 = 3 1/4* − t_1 = 39/16"

FOR SSE:
FROM EQ. 10.4 OF REF 21,
ASSUME |k = 0.2| OR, α = 53.13°
FROM TABLE 10.2, FOR k = 0.2,
C_c = 1.218
C_t = 2.661
z = 0.459
j = 0.776

(for calc. t_1 used f_s = 34.2
" " t_2 " f_{tc} = 2.38
$k = \frac{1}{1 + \frac{34.2}{7.74 \times 2.38}} = 0.35$
and C_c = 1.64 C_t = 2.3?
z = 0.427 j = 0.7?)

FROM EQ. 10.25, WITH d = 2R, f_s = FALL,

(f_s = 0.9 × 38.0 = 34.2)

$t_1 = \frac{M_S - Pzd}{f_s R C_t j d}$ = 0.612" FOR SSE CONDITION

$t_1 = \frac{3,267,120 - 9100 \times 0.459 \times 304}{34.2 \times 152 \times 2.661 \times 0.776 \times 304} = 0.6121"$) − 6.02.

* WIDTH OF SEISMIC ANCHORAGE PLATE

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WHICH IS LESS THAN THE 15/16" THICK SKIRT SUPPLIED. ALSO, NOTE THE MAXIMUM SKIRT STRESS IS:

$\sigma_{SSE} = \frac{0.612}{0.9375} \times 34.38 = 22.35$ ksi ✓

(AISC, Pg 347 E = 32,400,000 − 17,000 t; + RANGE) − 2000 → 1300)

FROM EQ. 10.28, WITH $\lambda = \frac{E_S}{E_C} = \frac{27.9 \times 10^3}{57\sqrt{4000}} = 7.74$ ✓

(ACI (for concrete mix) 318-71 CHAP 8 FOR NORMAL CONC. $E_c = 57000\sqrt{f'_c}$ psi)

$$t_2 = \frac{P + [C_T f_s - C_c f_c \lambda] R t_1}{C_c f_c R}$$

($0.9 \times 38.0 = 34.2$)

$t_2 = \frac{9100 + [2.??? \times 34.2 - 1.218 \times 2.38 \times 7.74] 152 \times 0.612}{1.218 \times 2.38 \times 152} = 35.128$ → BY G.DZ.

FOR SSE, $f_c = 2.38$ ksi

(ACI 318-71 Para 9.2.1A Pg 26 & 10.14 Pg 33: $4000 \times 0.7 \times 0.85 = 2380$.)

AND,

$t_2 = 35.13$" FOR SSE CONDITION

WHICH IS LESS THAN THE 39 1/16 SUPPLIED. THEREFORE, THE SKIRT AND CONCRETE ARE ADEQUATE UNDER THE IMPOSED LOADING FOR SSE

FOR 1/2 SSE, ASSUME K = 0.35

(for $f_s = 19.3$ & $f_c = 1.5$ (assume) $k = \frac{1}{1 + \frac{19.3}{7.74 \times 1.5}} = 0.376$)

OR, $C_c = 1.64$
$C_t = 2.333$
$z = 0.427$
$j = 0.783$

(USED, STR. PR. 70, $f_s = 19.3$ ksi (For S_m); $M_s = (130,000 + 2260) \times 12 = 1,947,120$) G.DZ

∴ $t_1 = 0.105$, $\sigma_{skirt} = 2.16$ ksi ($t_{supp} = 15/16$ ∴ ok.)
$t_2 = 37.70$ w/ $f_c = 1.5$ ksi ($t_{supp} = 39 1/16$)

∴ SKIRT AND CONCRETE ARE ADEQUATE FOR 1/2 SSE LOADING.

$\sigma_{act} = \frac{0.105}{0.9375} \times 19.3 = 2.16$ ksi

$t_1 = \frac{M_s - P z d}{f_s R C_t j d} = \frac{1,947,120 - 13,680 \times 0.427 \times 304}{19.3 \times 152 \times 2.333 \times 0.783 \times 304} = 0.105$"

$t_2 = \frac{P + [C_T f_s - C_c f_c \lambda] R \times t_1}{C_c f_c R} = \frac{13,680 + [2.333 \times 19.3 - 1.64 \times 1.5 \times 7.74] 152 \times 0.105}{1.64 \times 1.5 \times 152} = 37.695$

G.DZ.

P/M
DWG D-2

ANCHOR BOLT DESIGN:

FOR 180 - 3"φ ANCHOR BOLTS OF A-307 MATERIAL, WITH A TENSILE STRESS AREA OF 5.97 IN² (3-4UNC-2A), THE FORCE / BOLT IS CALCULATED AS FOLLOWS:

FOR SSE, LOAD = (22.32 * 15/16) * 2πR/180
= 111.07 kips

OR $\sigma_{BOLT} = \frac{111.07}{5.97}$ = 18.60 ksi ≤ 0.9 * (.9 Fy)* = 29.16 ksi

∴ BOLTS SHOWN ARE ADEQUATE.

*ASSUME THE YIELD OF A-307 MATERIAL IS 90% OF A-36's YIELD OF 36 ksi

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BASE PLATE DESIGN: DESIGN ASSUMPTIONS

THE BASE PLATE WILL BE DESIGNED TO TRANSMIT THE SKIRT LOAD TO THE ANCHOR BOLTS. THE ANALYSIS WILL ASSUME THAT A 5½" WIDE BEAM (EQUAL TO THE WIDTH OF THE WASHER), 9¼" LONG WILL CARRY THE MAXIMUM LOAD OF THE TWO BOLTS. A PLASTIC ANALYSIS WILL BE USED WITH A LOAD FACTOR OF 1.0 (YIELD CRITERIA)

A FIXED-FIXED BEAM WILL BE ASSUMED. THIS IS JUSTIFIED IN THAT THE BOLTS AND PLATE WASHERS WILL PREVENT ROTATION AT THEIR LOCATION.

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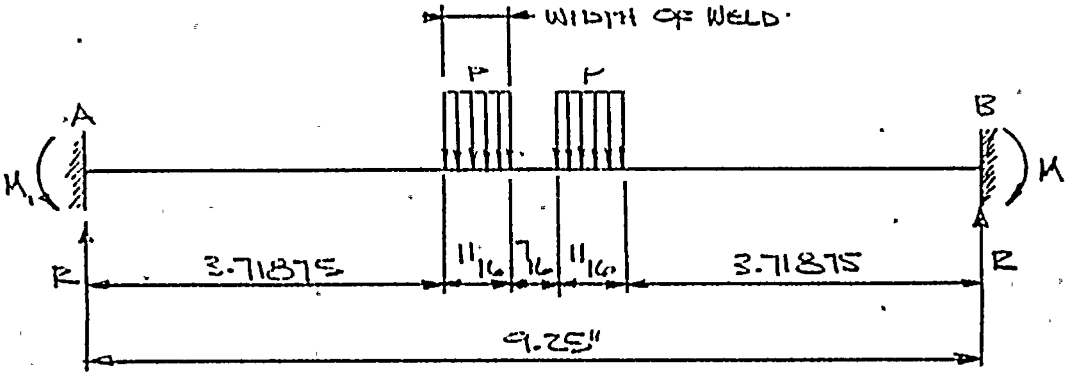
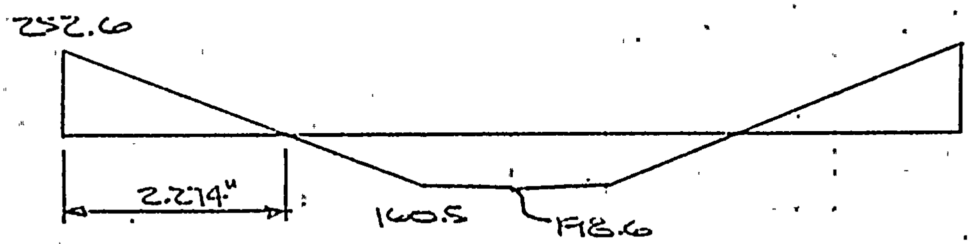


THE TWO LOADS "P" ARE THE EFFECTIVE BOLT LOADS WHICH ARE LOCATED AT "A" & "B"; OR,

FROM PAGE II.6.4.4 OF THIS FINAL STRESS REPORT,

$$P = 111.07 \text{ kips.}$$

SOLVING FOR END MOMENTS, $M_1 = 252.6$ IN kips AND THE MOMENT DIAGRAM IS AS FOLLOWS:



FOR THE 5½" WIDE BEAM, THE PLASTIC MODULUS IS:

$$Z = \frac{bt^2}{4} = \frac{(5\tfrac{1}{2})(3)^2}{4} = 12\tfrac{3}{8} \text{ in}^3$$

THE ALLOWABLE PLASTIC MOMENT IS THEREFORE CALCULATED AS:

$$M_P^{ALL} = S_y Z \times 0.9$$

OR

$$M_p = (12^3 8)(38)(.9) = 423.2 \text{ IN kips}$$

THIS IS GREATER THAN THE APPLIED MOMENT. THE 3" THICK BASE PLATE IS THEREFORE ADEQUATE. (FACTOR OF SAFETY = 1.68 ≅ AISC NORMAL ALLOW. OF 1.70)

SIMILARLY, IF A PINNED-PINNED BEAM, THE WIDTH OF WHICH WAS EQUAL TO THE CIRCUMFERENTIAL DISTANCE BETWEEN BOLTS, WAS ASSUMED,

$$M_p = ZS_y * .9 = \frac{\left(\frac{2\pi R}{90}\right) t^2}{4} * .9 S_y = \frac{\left[\frac{(2)(52)(\pi)}{90}(3)^2\right]}{4} * 38 * .9$$

$$M_p = 816.56 \text{ IN kips}$$

THE MAXIMIUM MOMENT PRESENT IS $(111.07)(4.625 - .5625)$ OR

$$M_{ACT} = 451.22 \text{ IN kips} < M_p \quad (F.S. = 1.81 \cong 1.70)$$

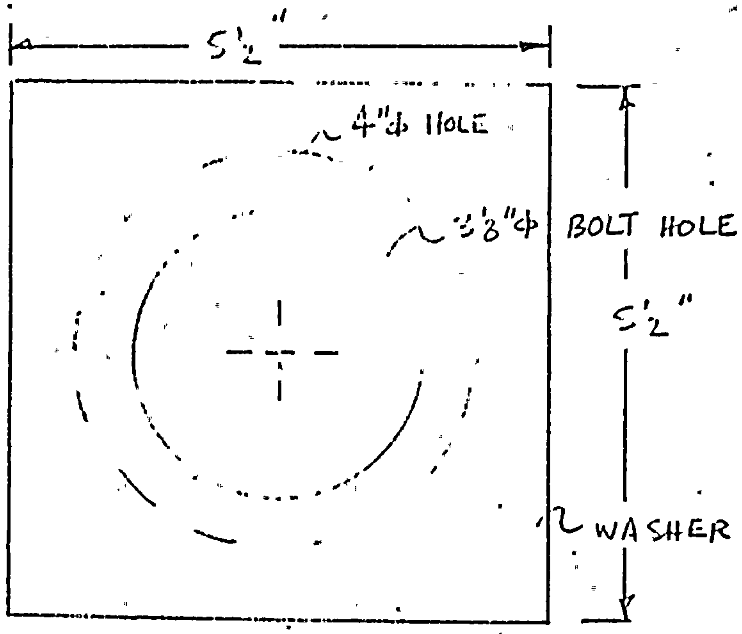
THEREFORE, THE 3" THICK BASE PLATE IS ADEQUATE. (IT SHOULD BE NOTED THAT THE ABOVE ANALYSIS IS CONSERVATIVE IN THAT BEAM FLEXURAL THEORY WAS ASSUMED, WHEREAS PLATE BENDING ACTION IS PRESENT IN THE ACTUAL STRUCTURE.)

FOR THE 5½" WIDE BEAM, THE MAXIMIUM SHEAR STRESS IS CALCULATED AS:

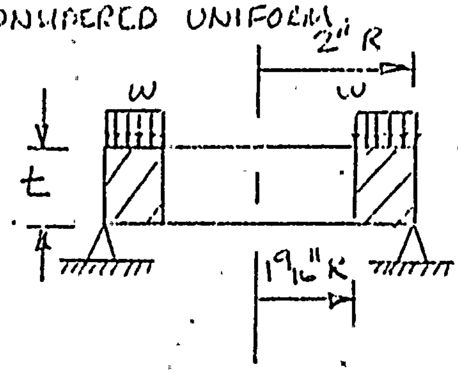
$$\left.\begin{array}{l} Q = (5\tfrac{1}{2})(1\tfrac{1}{2})(\tfrac{3}{4}) \\ I = (5\tfrac{1}{2})(3)^3/12 \\ V = 111.07 \\ t = 5\tfrac{1}{2} \end{array}\right\} \tau_V = \frac{VQ}{It} = \frac{(111.07)(5\tfrac{1}{2})(1\tfrac{1}{2})(\tfrac{3}{4})}{\frac{(5\tfrac{1}{2})(3)^3}{12}(5\tfrac{1}{2})} = 10.10 \text{ ksi}$$

$$\tau_{ALL} = \frac{0.9 F_Y}{\sqrt{3}} = 19.75 \quad \therefore \text{ OK}$$

ANCHOR BOLT DESIGN; ANALYSIS OF 5½" ф WASHER



IDEALIZE THIS BY USE OF ROARK CASE #13 (REF. 5, P. 220)
ASSUME 4"ф HOLE GIVES THE WASHER SIMPLE SUPPORT
ALL THE WAY AROUND. USING A 4⅝ X 5⅝ HEAVY HEX. NUT
THE LOAD WILL BE CONSIDERED UNIFORM.



ROARK CASE #13

W = TOTAL APPLIED LOAD

FOR 3"ф A307 BOLTS, W = 111.07 kips

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$$\omega = \frac{W}{\pi(a^2-b^2)} = \frac{111.07}{\pi(2^2-1.5625^2)} = 22.7\ K/IN^2$$

$$t^2 = \frac{3w}{4ms(a^2-b^2)}\left[a^4(3m+1)+b^4(m-1)-4ma^2b^2-4(m+1)a^2b^2 * \ln a/b\right]$$

$$t^2 = \frac{3*22.7}{4*3.333*1*38*1.5586}\left[2^4*11+1.5625^4(2.333)-4*3.333*2^2*1.5625^2-4*4.333*2^2*1.5625^2*\ln 2/1.5625\right]$$

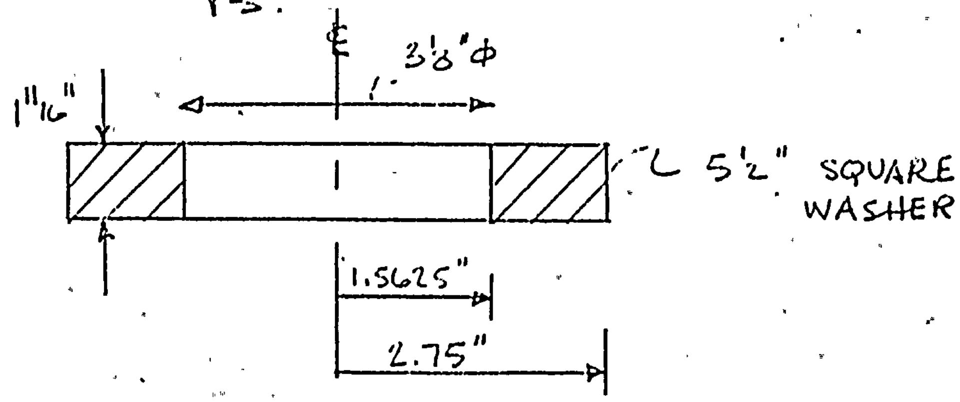
$t = 1.641"$

USE $t = 1\frac{1}{16}"$

CHECK FOR SHEAR IN WASHER ABOVE EDGE OF 4"ϕ HOLE :

$$\tau = \frac{\text{TOTAL LOAD (W)}}{2\pi a t} = \frac{111.07}{2\pi * 2. * 1.6875} = 5.2\ KSI$$

ALLOWABLE $\tau = \frac{0.9F_y}{\sqrt{3}} = 19.7$ KSI > 5.2 KSI O.K.



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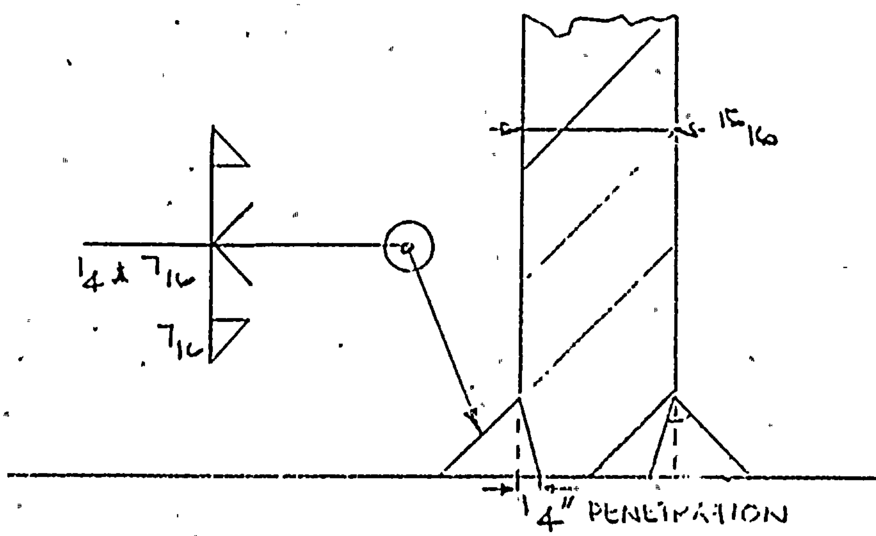
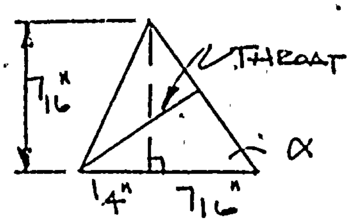




THE MAIN OBJECTIVE HERE IS TO OBTAIN AN EFFECTIVE THROAT OF 15/32 FOR EACH WELD

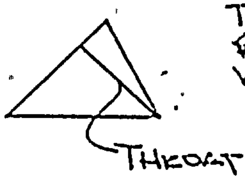
$\alpha = TAN^{-1}(7/16 / 7/16) = 45°$

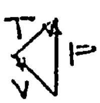
THROAT = $SIN\alpha * (7/16 + 1/4) = .486/SIDE$

OR, TOTAL EFFECTIVE THROAT = .972 > 15/16 = .9375

CHECK STRESSES IN WELD:

LOAD/IN. = 22.33 * 15/16 = 20.93 K/IN, OR 10.5 K/WELD





$T = V = P\cos 45° = 7.42$ K/IN

$\therefore \tau_V = \tau_T = \frac{7.42}{.486} = 15.3$ ksi

$\tau_T^{ALL} = 0.9F_Y = 34.2$ ksi

$\tau_V^{ALL} = 0.9F_Y/\sqrt{3} = 19.7$ ksi

} ∴ WELD OK

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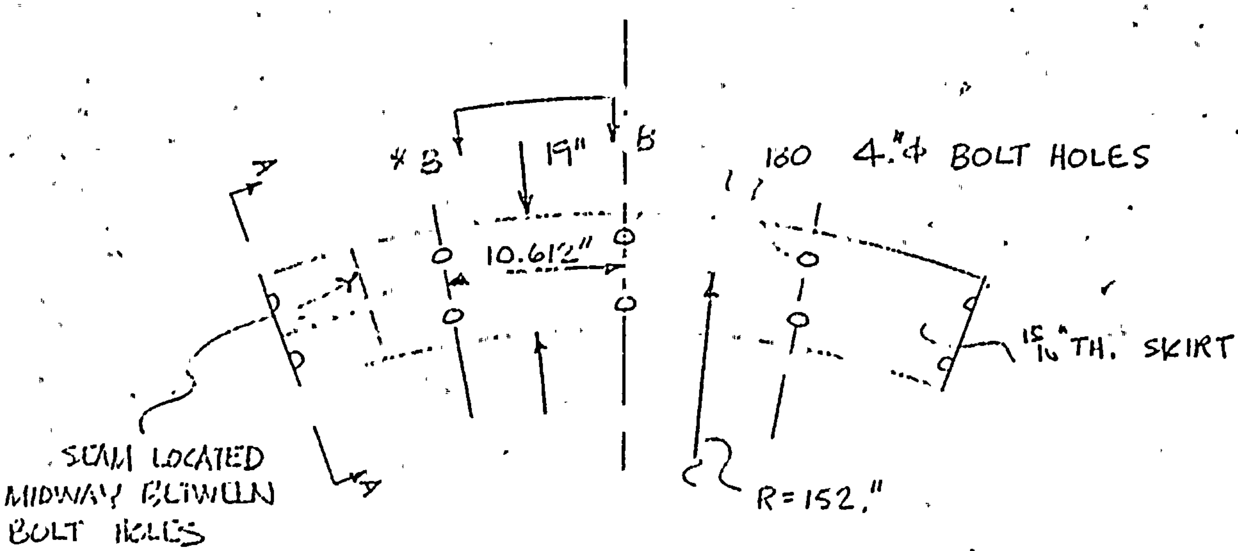
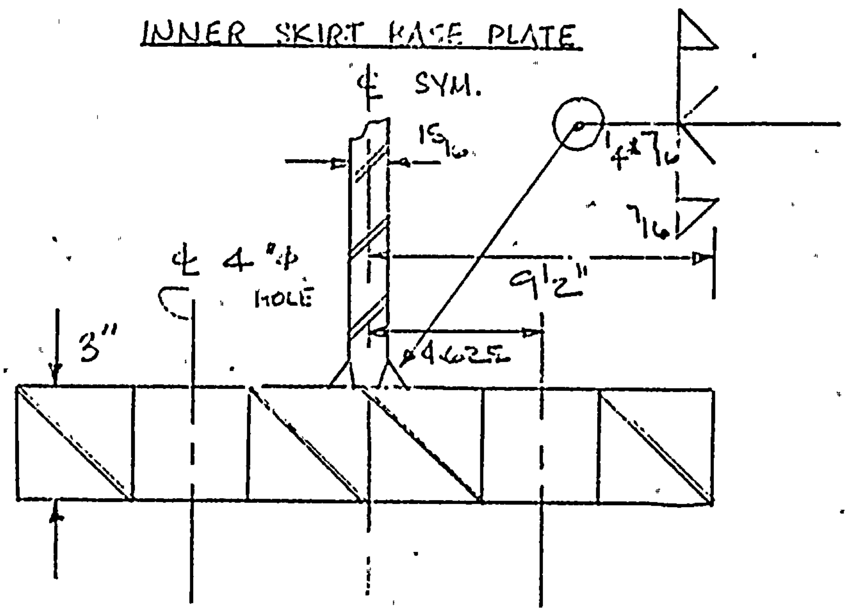


INNER SKIRT BASE PLATE



SECTION A-A (TYPICAL ACROSS BOLT HOLES)

* SECTION B-B SHOWN ON FOLLOWING PAGE

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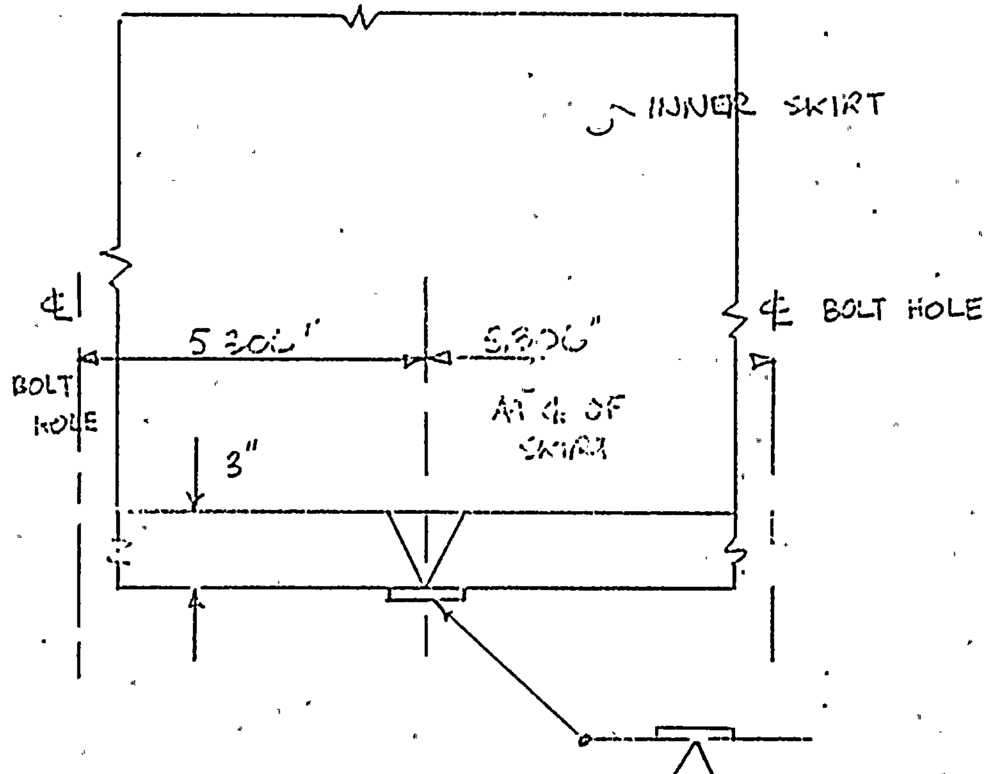

SECTION B-B (FROM PREVIOUS PAGE)

PITTSBURGH - DES MOINES STEEL CO. CONTRACT NO. 12764				FINAL STRESS REPORT	SECTION: II
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DESIGN OF SHEAR PLATES

FOR DESIGN PURPOSES, CONCRETE SHRINKAGE WILL BE ASSUMED SUCH THAT CLEARANCE WILL EXIST BETWEEN THE SHEAR PLATE AND THE CONCRETE EXCEPT AT THE MIDDLE. (SEE FIGURE A-1)

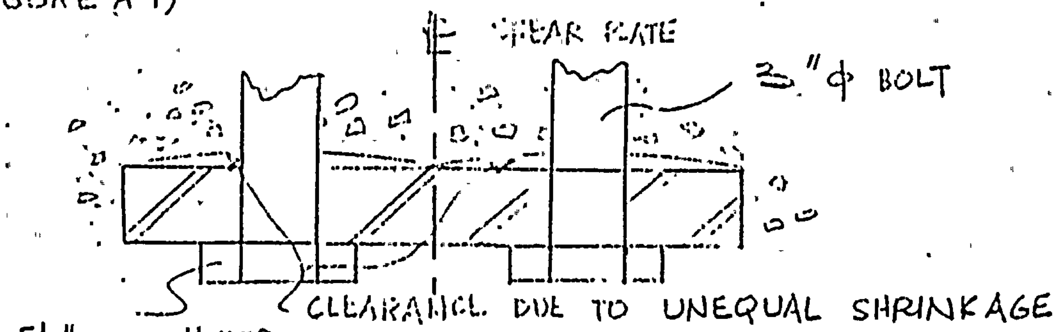

FIGURE A-1

THE SHEAR PLATE WILL THEN BE DESIGNED AS TWO SIMPLY SUPPORTED PLATES INSTEAD OF A CONTINUOUS PLATE. THIS APPROACH IS CONSERVATIVE SINCE MOMENT CARRYING CAPACITY IN THE MIDDLE OF THE SHEAR PLATE IS IGNORED. ROARK CASE 31 (SEE REFERENCE 5) WILL BE USED TO ANALYZE THE SHEAR PLATE.

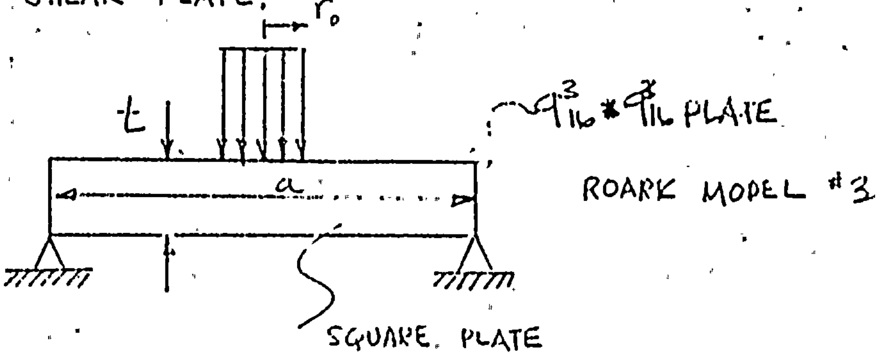

FIGURE A-2

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ALLOWABLE BEARING ON THE CONCRETE = .7 * .85 * 4000 = 2380 PSI

BOLT LOAD = 111.07 kips

ASSUME AN ANNULAR PLATE 40° O.C. OR LENGTH = $2\pi R\alpha/360$ = 106.12 IN

WIDTH = 18.375" OR AREA = 1808.56 IN² ($1949.96 - 20 * 1.5^2 * \pi$) ← BOLT HOLES

ALLOWABLE LOAD = 2.38 * 1808.58 = 4304 K > 20 * 111.07 = 2221.4 K ∴ OK

FROM ROARK CASE 31 (REF. 5):

$$s = -\frac{3W}{2\pi m t^2}\left[(m+1)\log\frac{a}{2r_0} + .75m\right]$$

TAKEN AT CENTER. SYMBOLS ARE AS DEFINED IN ROARK

$W = 111.07$ K, $r_0 = 2.75$, $a = 9\frac{3}{16}$, $s = .9 * 38$ ksi (PLATE ALLOWABLE FOR FULL SEISMIC)

$$t^2 = \frac{3 * 111.07}{2 * \pi * 3\frac{1}{3} * 38 * .9}\left[4\frac{1}{3} * \log\frac{9\frac{3}{16}}{5.5} + 2\frac{1}{2}\right]$$

$t^2 = 2.197$ IN²

$t = 1.48$ IN $\qquad t = 2\frac{1}{4}$ IN

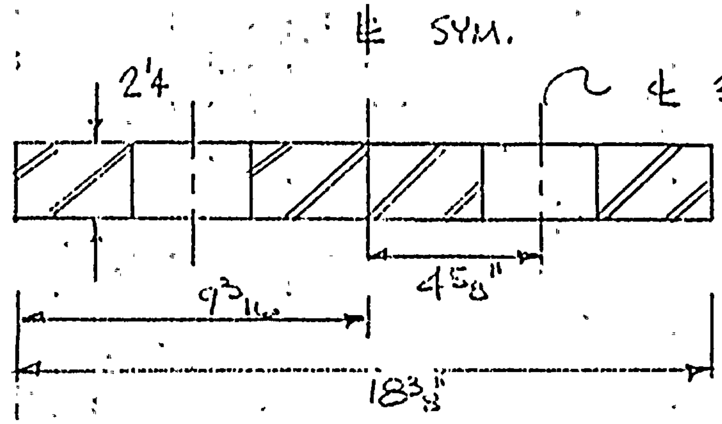

FIGURE A-3

USE 18⅜" x 2¼" THK ANNULAR SHEAR PLATES W/ 3⅜"⌀ HOLES.

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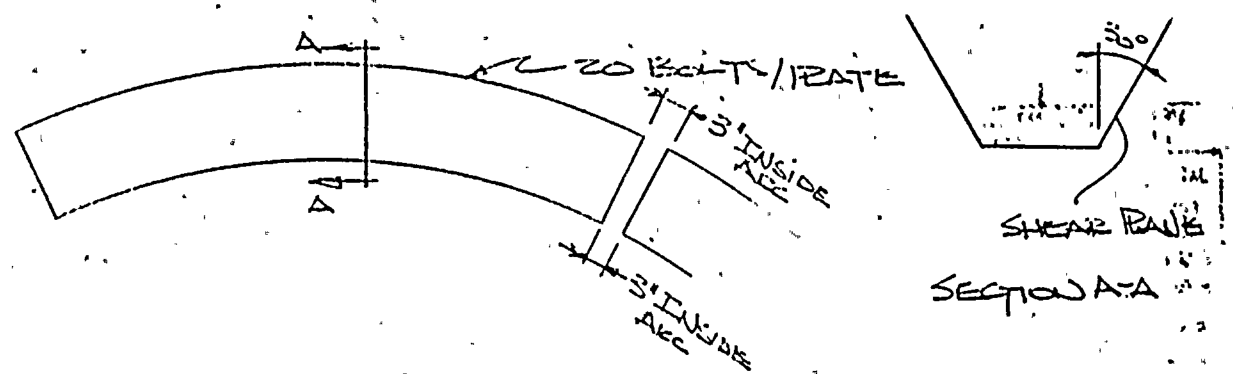
CHECK PUNCHING SHEAR THRU CONCRETE:

ASSUME 9 ANNULAR SHEAR PLATES, WITH 3" BETWEEN PLATES:



IF ASSUME TOTAL LOAD (CONSERVATIVELY) EQUALS 20*111.07 = 2221.4 KIPS, AND INNER AND OUTER SHEAR PLATE ARCS ARE $2\pi R/9 - 3" = 96.70$ AND $2\pi R/9 - 3.0 = 109.53$ IN. IF IT IS ASSUMED THAT NO SHEAR CAN BE TAKEN ON THE ENDS OF THE ANNULAR PLATE, THEN THE CIRCUMFERENCE EQUALS 206.23 IN FOR A LOAD FACTOR OF 0.85, AND AN ALLOWABLE CONCRETE SHEAR STRESS OF $4\sqrt{f'_c}$, ASSUMING A 30° SHEAR PLANE, THE DEPTH REQUIRED IS:

$$l = \frac{2221.4 * 10^3}{(.85)(206.23)(4)\sqrt{4000}} * \cos 30° = 43.4 \text{ IN}$$

$\therefore$ USE $l = 78" - 2\frac{1}{4} = 75.75$ in.