Enclosure 2

nutech ENGINEERS

145 MARTINVALE LANE • SAN JOSE, CALIFORNIA 95119 • PHONE (408) 629-9800 • TELEX 352062

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Mr. John P. Roberts
Project Manager
Advanced Fuel and Spent Fuel
Licensing Branch
Division of Fuel Cycle and Material Safety
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Dear John:

Attached are responses to your detailed comments on our Topical Report for the NUTECH Horizontal Modular Storage System for Irradiated Nuclear Fuel (NUH-001); Project No. M-39. The Topical Report will be revised to reflect these responses to your comments. If you have any questions concerning our responses please contact us.

Very truly yours,

John V. Massey

John V. Massey, Ph.D.
Engineering Manager, Fuel Cycle
and Waste Management Programs

JVM/jj

Attachment

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DETAILED COMMENTS ON NUTECH
TOPICAL REPORT NUH-001

QUESTION: 1

1.0 INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

1.1 Introduction

A helium storage atmosphere is specified within the DSC. What measures has NUTECH taken to assure that the helium initially placed in the DSC will not leak to the atmosphere? What is the maximum leakage rate considering the integrity of all welds and diffusion through the canister? What measures are available to monitor the DSC atmosphere composition?

RESPONSE:

NUTECH has included a number of measures in the design, fabrication, and operation of NUHOMS that will ensure the helium initially placed in the DSC will not leak to the atmosphere. The longitudinal and bottom closure welds of the DSC are designed and will be fabricated in accordance with the ASME Boiler and Pressure Code, an internationally accepted code for the design and fabrication of leak tight containment vessels. The design of the DSC includes redundant closure welds on the top. All welds that are on the pressure retaining boundaries of the DSC will undergo nondestructive examination. The nondestructive examination includes:

- Ultrasonic or Radiographic Testing	o All shop welds on pressure retaining boundaries o Secondary closure welds
- Dye Penetration	Primary closure weld
- Helium Leak Test	Primary closure weld

These measures will assure that neither the helium initially placed in the DSC will not leak to the atmosphere nor the atmosphere, containing corrosive agents, leak into the DSC.

In regards to diffusion, discussions with scientists in the helium industry (at Union Carbide and the U.S. Bureau of Mines' Helium Operation) indicate that as a practical matter, helium does not diffuse through steel or stainless steel. The scarcity of references in the

RESPONSE: (Continued)

literature seems to bear this out. The Metals Handbook, R.M. Parke takes the position that "Helium does not diffuse through solid iron".

However, since the reviewers' concern with diffusion is evident, we have conservatively calculated the diffusion rate to be on the order of 10^{-8} g-moles/year at nominal design conditions. Diffusivity for this system varies exponentially with temperature so that in an accident condition with elevated temperatures, the diffusion rate could be expected to increase by as much as 3 orders of magnitude. However, even at this magnitude, the leakage rate would remain of no practical consequence.

Based on the above discussion, no measures are required for monitoring the DSC atmosphere composition.

QUESTION: 2

1.2.1 General Description of Installation

Even though it may be possible to design a single stand-alone horizontal storage module (HSM) or physical arrangements in other than a 4x2 array, the design contained in the current Topical Report is limited to a 4x2 array (see p. 8.2-13). The Topical Report should clearly state which arrangements(s) are being proposed for review and maintain consistency throughout the document.

RESPONSE:

The 4x2 array is the only design which is to be reviewed in this Topical Report. The Topical Report will be revised so that consistency is maintained throughout the document.

QUESTION: 3

1.2.2 Principal Design Criteria

1. Are there limits on the kind of external atmosphere allowed for this system in order to control corrosion of exposed surfaces or to control growth of algae or other vegetative matter within the HSM? Please discuss.

RESPONSE:

Because of the corrosion resistant properties of components and coatings used in construction of the NUHOMS system and the harsh environment which exists within the HSM, no limits on the kind of external atmosphere are required.

All components are either 304 stainless steel or ASTM 36 steel, coated with Carbo Zinc 11, an inorganic zinc based corrosion protection coating or galvinized in accordance with ASTM standards.

The interior of the HSM is all cement and steel and is void of any substances which would be conducive to the growth of organic matter. A drainage line in the air inlet chamber has been incorporated into the HSM design. The drainage line will drain any water which enters through the air inlets. The air outlets located on the roof of the module are designed to be water tight. However, if any water enters into the HSM cavity by this route, will evaporate long before any vegetative matter could establish itself and disrupt the air flow through the HSM. The evaporation will be rapid because the module floor is 50 to 70°F above the incoming air temperature due to the heat radiated from the canister. Additionally, as documented in many studies on the environmental effects of radiation, radiation is not conducive to the growth of organic matter.

QUESTION: 4

1.2.2 Principal Design Criteria

2. No mention is made of the duty cycle allowed for the materials (particularly concrete). Please provide some discussion of how the duty cycles are addressed or why they do not need to be addressed.

RESPONSE:

According to the ASHRAE Handbook, 1981 Fundamentals, the largest mean daily change of temperature in the United States occurs in Reno, Nevada and is 45°F. Assuming this maximum temperature change occurs every day for 50 years the HSM will experience 18250 thermal cycles. The maximum moment caused by normal operating thermal loads, as reported in the Topical Report is 2496.2 k-in. This loading is only 62% of the ultimate strength. By assuming this entire amplitude to be cycling daily, which conservatively envelops the 45°F daily mean, and referring to the S-N curve of Figure 6-41 of the Handbook of Concrete Engineering by Fintel, the number of cycles before failure will occur is approximately 10,000,000. Since this value is far greater than the 18250 cycles, fatigue failure of concrete should not occur.

To show the negligible effect of the duty cycle on the fatigue strength of the DSC the fatigue analysis of section 8.2.10 is reexamined. Overly conservative assumptions are made and daily thermal/pressure cycling is included in this analysis. Conservatively, the operating pressure loading is assumed to change from zero to operating pressure each day. Secondly, accident pressure loading is assumed to occur once a year for each of the 50 years of design life. One major seismic event is assumed to occur with 100 damaging cycles. For seasonal changes, a $\Delta T = 175.7°F$ is used which envelopes the ΔT from the -40°F to +125°F inlet temperature load cases. As stated previously the largest daily range in the United States is 45°F. This ΔT is applied each day for the 50 year lifetime to account for daily temperature cycling. All of the five (5) loadings are combined in a histogram. ASME Figure I-9.2 is used to determine the fatigue usage factor for the DSC shell. A value of 0.21 was calculated; therefore, the DSC shell is adequate for cyclic loadings.

QUESTION: 5

1.2.4 Safety Features

What are the values for cask movement, cask head and truck transport which were not included in Table 1.2-4?

RESPONSE:

There are no values associated with cask movement, cask head, and truck transport. These are operational capabilities which a system must include in order to be compatible with the NUHOMS system. Table 1.2-4 will be revised to indicate N/A for these parameters.

Some of the qualitative parameters which must be satisfied in order to be compatible with the NUHOMS system are listed below.

The combined weight of the cask and the loaded DSC must not exceed the lifting capacity of the sites existing spent fuel handling crane.

The cask must be capable of being rotated from a vertical position to a horizontal position.

The cask lid must be removable while the cask is in a horizontal position.

The size of the cask and the combined weight of the cask and the loaded DSC must not be so excessive that they could not be economically transported to the HSM by a tractor-trailer arrangement.

QUESTION: 6

3.0 PRINCIPAL DESIGN CRITERIA

3.1.1.1 Physical Characteristics

Based on the data on pages 3.1-1 and 3.1-3 it appears that NUTECH has used the Westinghouse fuel assembly array of 15x15/204. Examination of the data in Table 3.1-2 reveals that several fuel arrays are not enveloped by the 15x15/204 array, namely the B&W 15x15/208, the B&W 17x17/264, the CE 15x15/208, 212 and 216, and the CE 16x16/224 to 236. The text and the tables should be consistent and any fuel assembly types not enveloped by the design criteria case should be deleted or the design modified to envelope all the listed fuel types. In addition to these comments, are there any design parameters of the reference fuel assembly physical characteristics which would lead to a non-conservative analysis?

RESPONSE:

The main structural criteria used to establish the enveloping fuel assembly is the weight distribution per spacer disk. Spacer disks are located at fuel assembly grid spacer locations to assure proper support. The weight per spacer disk is obtained by multiplying the distributed weight times the maximum length between spacer disks. The following table shows the weight per spacer disk for the various assemblies.

Fuel Assembly	Wt. Per Spacer Disk (kg)
Westinghouse 15x15/204	106.56
B&W 15x15/208	87.73
B&W 17x17/264	90.41
CE 14x14/176	64.14
CE 15x15/208, 212, 216	127.46 (Not Enveloped)
Westinghouse 14x14/179	93.15
Westinghouse 17x17/264	101.66

As this table shows, the Westinghouse 15x15/204 envelopes all fuel assemblies in Table 3.1-2 except the CE 15x15/208, 212, 216. These PWR fuel assemblies will be deleted from Table 3.1-2.

Although of the aforementioned assemblies weigh more than the Westinghouse 15x15/204, the maximum increase is only 83.8 lb per assembly or 583.1 lb per canister. This causes the dead weight of the loaded canister to increase from 21236 lb to 21819 lb. This 2.7% increase will cause only minimal stress increases in the DSC shell, DSC support assembly, and the HSM. Since significant safety margin exists for these components, the 2.7% increase is negligible.

No other design parameters exist for the referenced fuel assemblies which could lead to non-conservative analyses. Consequently all fuel assemblies in Table 3.1-2 are enveloped except the CE 15x15/207, 212, 216. These fuel assemblies will be deleted from the table.

QUESTION: 7

3.1.2.2 Handling and Transfer Equipment

1. If NUTECH intends to assume that the transfer cask will be handled in the reactor building and during loading of the cask onto the transfer vehicle by a single failure-proof crane, it should state that criterion in this section.

RESPONSE:

The transfer cask and irradiated fuel will be handled within the fuel pool and reactor building in accordance with the requirements and criteria already approved in the sites FSAR and in accordance with the sites existing procedures. Information on cask and fuel handling procedures must be provided on a site specific basis. These procedures will insure that the transfer cask is handled in a manner that will not present a safety hazard. That is, the impact energy absorbing properties of the cask in use and the limitations on the drop height are such the resulting impact deceleration is enveloped by the values given in section 8.2 of the Topical Report.

QUESTION: 8

3.1.2.2 Handling and Transfer Equipment

2. In order for the five foot horizontal drop criterion to be valid, NUTECH should specify dimensional criteria for the cask skid and the transfer trailer to show that the maximum conceivable horizontal drop height is five feet of less.

RESPONSE:

The type of cask and transfer trailer is site specific and should be included in the site's FSAR. The Topical Report will be changed to state that the limitation is the enveloping deceleration load for which the DSC was designed (Section 8.2), not a drop height. The five foot drop criterion previously specified corresponds to the maximum deceleration which the DSC is capable of withstanding in a GE IF-300 cask dropped on an unyielding surface. Different cask, trailers, and ground conditions at various sites may significantly effect any actual drop height limitation. Indeed, drops on actually existing surfaces at reactor sites will yield much higher allowable drop heights.

QUESTION: 9

3.1.2.2 Handling and Transfer Equipment

3. What vertical acceleration factors have been measured or will be assumed for design criteria for the transportation of the GE IF-300 cask loaded with the NUTECH DSC while being transported on the trailer? Show that these accelerations have been enveloped by the five foot drop analysis.

RESPONSE:

The vertical acceleration which the DSC will be subjected to while in transport to and from the HSM will depend on the type of trailer, travel speed of the trailer, and type of road surface. All these factors are site specific.

However, it is noted that 10 CFR71.31 (d) (1) requires the vertical acceleration design criteria for cask tie downs to be 2g. If this same criteria is assumed to be applicable for the transportation of the DSC to and from the HSM, then this design criteria is bounded by the acceleration term associated with the drop accident analysis reported in section 8.2 of the Topical Report.

QUESTION: 10

3.2 Structural and Mechanical Safety Criteria

Pages 3.2-4, 8.2-53 and 8.2-56 show inconsistent maximum internal pressurization levels of 44 and 39.7 psig. Also, associated with these pressures are inconsistent temperature levels of 423° and 413°C. NUTECH should state what the actual design parameters are and use them consistently throughout the Topical Report.

RESPONSE:

New helium filling procedures have been developed. Table 3.2 below lists the internal pressure of the DSC, for both normal and abnormal conditions (100% rod fill gas release and 25% fission gas release) The Topical Report will be revised to include these new pressures and checked to ensure consistency throughout.

Table 3.2

Case	Air Temperature °F	Average Helium Temperature °F	Helium Pressure (Psia)	Partial Pressure[1] Fission of Fill Gas (Psia)	Total Pressure (Psia)	Total Pressure (Psig)
1	-40	315	14.2	20.92	35.12	20.42
2	70	389	14.5	22.92	37.42	22.72
3	125	429	15.2	23.99	39.19	24.49
4	Inlets Plugged	502	16.4	25.97	42.37	27.67
5	Complete blockage of inlets and outlets	775	21.05	33.33	54.38	39.68

(1) 100% of rod fill gas and 25% of fission gas released.

QUESTION: 11

3.2.3.1 Seismic Design

1. It is stated on Page 3.2-10 that a damping value of 2 percent of critical damping should be used for a large diameter piping system under a safe shutdown earthquake. This damping value is taken directly from NRC Regulatory Guide 1.61. Shouldn't this damping value be 3 percent?

RESPONSE:

The damping value of 2 percent has been changed to 3 percent.

QUESTION: 12

3.2.3.1 Seismic Design

2. It is stated on page 3.2-10 that the maximum horizontal ground acceleration selected for the design of the NUHOMS is 0.25g and the maximum vertical acceleration component selected is 0.1g. It is further stated in this paragraph that these ground acceleration values correspond to certain recommendations contained in 10 CFR 72.66(2)(ii). There does not appear to be any reference to a vertical ground acceleration level anywhere in 10 CFR 72.66. There is a reference in 10 CFR 72.66(a)(6)(ii) to a standardized ISFSI design earthquake response spectrum anchored at 0.25g. NRC Regulatory Guide 1.60 states that, depending on excitation frequency, that the vertical component of the design response spectra should be either the same as or 2/3 of the corresponding horizontal design spectra. Shouldn't the maximum vertical acceleration component selected for use in designing the NUHOMS be at least 0.17g rather than 0.1g if the maximum horizontal component is 0.25g?

   Additional guidance is given in NUREG-0800, Section 3.7.1 p.3.7.1-4, "To be acceptable the design response spectra should be specified for three mutually orthogonal directions; two horizontal and one vertical. Current practice is to assume that the maximum ground accelerations in the two horizontal directions are equal, while the maximum vertical ground acceleration is 2/3 of the maximum horizontal acceleration."

RESPONSE:

The vertical ground acceleration will be increased to 0.17g. All associated analyses will be revised to incorporate this change.

QUESTION: 13

3.2.3.2 Seismic System Analysis

On page 3.2-11 it is stated that the concrete coefficient of friction of 1.0 is taken from the ACI 349-80 code. However, this is only valid if concrete is placed against hardened concrete and the interface between the concrete surfaces is clean, free of laitance and "intentionally roughened to a full amplitude of approximately 1/4 inch." In the absence of concrete surface preparation specifications, NUTECH should use 0.6 as stated in ACI 318-83 Section 11.7.4.3. This concern arises again in Chapter 8.

RESPONSE:

The concrete coefficient of friction will be changed from 1.0 to 0.6. The only area effected by this change is the sliding of the single HSM under various accident loads. If necessary, a shear key type of connection at the module walls or a tie-down system, depending on the type of concrete construction (i.e. cast in place vs precast) will be specified.

QUESTION: 14

3.2.5.2 Dry Shielded Canister

1. NUTECH has chosen ASME Level A service limits for normal operating conditions and Level D service limits for accident or faulted conditions. The use of Level D service limits, "permit gross general deformations with some consequent loss of dimensional stability and damage requiring repair, which may require removal of the component from service," (ASME, NCA - 2142.2(b)(4)). If Level D service limits are retained for accident or faulted conditions, NUTECH must state in the structural design criteria, that following an accident (such as the 5 foot drop and drop combined with pressure) which could cause damage to the DSC and DSC internal members, the DSC must be disassembled and inspected for damage.

RESPONSE:

The only accident condition that service level D allowables are used is the drop accident. For this condition the structural design criteria will be changed to state:

"Following a drop accident the DSC must be opened and fuel assemblies removed and inspected for damage."

QUESTION: 15

3.2.5.2 Dry Shielded Canister

2. If Level D service limits are used, can NUTECH assure that possible deformation within the DSC following an accident will not inhibit the easy retrieval of all fuel assemblies (see Question 8, under 3.3.4 below).

RESPONSE:

For the horizontal drop accident only two components in the DSC basket, the spacer disk and the boral tube, could possibly deform and cause interference with the fuel retrieval operation. To verify that no interference will occur, the maximum elastic deformation of the spacer disk and boral tubes obtained from the STARDYNE analysis (reported in section 8.2) will be conservatively added to the maximum possible plastic deformation and then compared to the minimum gap between the fuel assembly and the inside of the boral tube. The maximum elastic deformation of the spacer disk is .0301 inches at the fuel cell centerline. The maximum boral tube deflection is .0072 inches. An upper limit plastic analysis was performed for the spacer beams between two fuel cells, assuming a three hinged, uniformly loaded beam. The maximum deflection calculated was 0.016 inches. The actual plastic deformation is conservatively enveloped by this value. Since the boral tube stress is far less than yield stress, no permanent deformation occurs. Summing the total calculated deflections yields .0533 inches. The minimum gap is 0.324 inches. Consequently no interference for the horizontal drop accident is present.

For the vertical drop accident, the permanent deformation in the lead casing is significantly less than the ½ inch gap specified between top of fuel & bottom surface of top lead plug. Clearly then, no interference will occur which could inhibit the easy retrieval of all fuel assemblies.

QUESTION: 16

3.3.3.2 Instrumentation

It is stated that there is no need to monitor the DSC internal pressure or temperature. Limiting pressure and temperature values are based on calculations. How does NUTECH assure that the calculational techniques are qualified for use in the design?

RESPONSE:

The code used to calculate the temperatures is a fully benchmarked code and the version which NUTECH used is fully verified by the Vendor and meets all their quality assurance requirements. It is the code recommended by the NRC for such analysis and is used in the same manner as used by the NRC in the evaluation of cask internal temperatures.

QUESTION: 17

3.3.4 Nuclear Criticality Safety

1. Were analyses of reactivity as a function of the number of assemblies in the canister performed? During loading of the canister in the pool, does analysis show that an arrangement of fewer than seven assemblies does not have a larger reactivity than the completely loaded canister? Such a situation might be possible due to reflector effects.

RESPONSE:

Reactivity analyses were not performed as a function of the number of fuel assemblies in the canister. NUTECH's design basis for criticality control is the use of neutron poison (Boral) in all seven guide sleeves. (Refer to NUTECH response to question 5 of section 3.3.4). When the canister is loaded with less than seven fuel assemblies, several physical events take place which prevent the reactivity from being larger than when fully loaded.

Most significantly, a major source of reactivity (a fuel assembly) is removed from the system. To maintain the same reactivity, or a higher reactivity, a certain population of neutrons would have to pass through the vacant cell before striking an adjacent fuel assembly. Neutrons traveling through the cell must now pass through a total of four layers of boral. Since the cell contains only water, neutrons are more efficiently thermalized resulting in their accelerated removal from the population since boron is especially effective for thermal neutrons.

The system's reactivity must decrease since the neutron generation rate will be reduced, and since proportionally more neutrons will expire due to the increased effectiveness of the boral guide sleeves. If reflection is considered, the effect of the guide sleeves is amplified.

Furthermore, the unaccounted for (in the calculations) fission products in the fuel will always assure that the actual k_{eff} will be much less than the conservative k_{eff} calculated.

QUESTION: 18

3.3.4 Nuclear Criticality Safety

2. Were design clearances and fabrication tolerances considered in the criticality analysis? What are the design clearances that have been provided to ensure insertion and removal of the fuel elements in the guide sleeves? What is the worst case reactivity for a water flooded canister if the design clearances and fabrication tolerances are taken into account?

RESPONSE:

Original criticality analyses did not consider design clearances and fabrication tolerances. The seven fuel assemblies were assumed to be centered in the spacer disk cutouts.

A design clearance of 0.1525 inches at each edge of the fuel has been provided to assure insertion and removal of the fuel elements in the guide sleeves. Refer to question 3.2.5.2 for further details.

Additional calculations have been performed to determine the worst case reactivity for a water flooded canister if the design clearances are taken into account. The reactivities for cases where fuel assemblies are as far apart as possible and where they are as close together as possible are both lower than that calculated for the nominal case.

Thus, it is concluded that the variations in design tolerancing will not cause the reactivity to increase.

QUESTION: 19

3.3.4 Nuclear Criticality Safety

3. From the hydrogen and oxygen atomic densities in the KENO input it appears that a water density corresponding to 20 degrees Celsius has been assumed. How does this temperature compare to limits of the fuel pool temperature. If the temperatures are different, has analysis shown that the reported KENO results are conservative?

RESPONSE:

Fuel pool temperatures are typically no warmer than 100°-125°F (37.7°-51.7°C). The pool water was conservatively modeled at 20°C because, at lower temperatures, the hydrogen and oxygen densities are higher. Since hydrogen and oxygen are both effective moderators, their higher density results in more effective moderation of neutrons. Since the fission cross section of U-235 is much higher at low energies, more moderation leads to a higher reactivity. The modeling choice is therefore conservative since it results in a higher calculated reactivity than could reasonably be anticipated under actual plant conditions.

Furthermore, the unaccounted for (in the calculations) fission products in the fuel will always assure that the actual k_{eff} will be much less than the conservative k_{eff} calculated.

QUESTION: 20

3.3.4 Nuclear Criticality Safety

4. What are the errors or biases due to the cell homogenization procedure? If the biases have not been quantitatively evaluated, has it been shown that the biases are conservative?

RESPONSE:

Biases due strictly to the cell homogenization procedure have not been quantitatively evaluated. An overall bias was established by comparison of NUTECH criticality calculations to the benchmark results presented in NUREG/CR-0073.

The overall bias is in the nonconservative direction and has been accounted for as described in Section 3.3.4.3.

The homogenization process used by NUTECH is described in Section 2.1.3 of the SCALE Module CSAS2[1]. Bierman, Clayton, and Durst[2] report that fuel regions (pins) do not have to be discretely modeled in KENO IV calculations. The "smeared" modeling process produces more accurate results than discrete modeling.

(1) NUREG/CR-0200
(2) Bierman, Clayton and Durst, "Critical Separation Between Subcritical Clusters of 2.35 Wt% ^{235}U Enriched UO_2 Rods in Water with Fixed Neutron Poisons," Battelle Pacific Northwest Laboratories, PNL-2438, October 1977.

QUESTION: 21

3.3.4 Nuclear Criticality Safety

5. The design of the DSC apparently considers that some modules may use boron sleeves, while others may not. What controls are employed to ensure that low burnup assemblies are not inadvertently loaded into unborated canisters?

RESPONSE:

All seven sleeves will be constructed from boral. Any references in the Topical Report to the contrary will be removed or corrected.

QUESTION: 22

3.3.4 Nuclear Criticality Safety

6. What are the manufacturing tolerances of the boron content of the boral guide sleeves? Were the criticality analyses performed with a nominal boron concentration or a minimum concentration? If there is a difference, what is the magnitude of the effect on reactivity?

RESPONSE:

The manufacturing tolerance of the boron content of the Boral guide sleeves is directly related to the tolerance in the core panel thickness. Brooks & Perkins Product Performance Report 624 indicates a tolerance of ± 4 mils for a 75 mil thick Boral panel (which includes the core and cladding). It is assumed therefore that the boron content per unit area will vary no more than ± 5.3%.

Criticality analyses were performed with a nominal boron concentration.

NUTECH's scoping studies demonstrated that reactivity is relatively insensitive to small changes in boron concentration, if other parameters are unchanged. The data shows that when the B-10 concentration increases by 36%, the reactivity decreases by 2.7%. Another set of data shows a 1.8% increase in reactivity for a 22% reduction in B-10 concentration.

QUESTION: 23

3.3.4 Nuclear Criticality Safety

7. The dimensions shown in Figure 3.3-2 are inconsistent with the text and the KENO input. Is it correct to assume that the Figure is in error?

RESPONSE:

Figure 3.3-2 is in error. The following will be revised: 0.25 inches will read 0.025 inches, 0.75 inches will read 0.075 inches.

QUESTION: 24

3.3.4 Nuclear Criticality Safety

8. If Level D service limits are retained for the DSC, how would the multiplication factor be affected, should deformation of the DSC internals occur, when the canister is opened for inspection in the fuel pool? (Refer to Questions in 3.2.5.2 above).

RESPONSE:

The maximum departure from the nominal design condition is described in question 2 of section 3.3.4. No increase in system reactivity is expected as a result of fuel assembly movement. (see question 2 of section 3.3.4)

QUESTION: 25/26

3.3.4.3 Verification Analysis

1. Have other calculations been performed to verify that the implementation of the KENO-IV computer program used for the criticality analysis produces results with expected statistical dispersions?

   If only three benchmark calculations have been calculated for the verification analysis, can a statistically significant determination of the proper and expected operation of the computer code be made.

RESPONSE:

KENO-IV has been fully verified by Boeing Computer Services in accordance with their QA program.

The intent of NUTECH's benchmark calculations using KENO-IV was to verify an adequate analytical technique (i.e., homogenization procedure, appropriate computational flow path and data, etc.) and to establish the bias produced by that technique. No effort was made to determine the proper operation of KENO-IV by executing a "statistically significant" number of calculations. The operation and statistical significance of the KENO-IV program has been verified numerous times by others.

QUESTION: 27

3.3.4.3 Verification Analysis

2. What is the justification for the selection of the BNL critical experiments for the verification analysis and in particular the selection of the three experiments that were calculated? Were other series of critical experiments considered? If not, why not?

RESPONSE:

The three BNL experiments were chosen because of their similarity to the NUHOMS system, and in particular to their similarity to the reactivity control materials used in NUHOMS.

Other series of experiments were not chosen due to their lack of similarity to the NUHOMS design.

QUESTION: 28

3.3.4.3 Verification Analysis

3. Table 3.3-5 shows the results of the NUTECH calculations of the benchmarks as the mean value plus two standard deviations. While this is the accepted conservative value for criticality design calculations, it is not the correct value to determine the computational bias. The mean value should be compared with the experimental results. What are the mean value and standard deviation of the benchmark calculations?

RESPONSE:

The mean value of the benchmark calculations is 0.964. The average standard deviation is 0.00544.

Table 3.3-5 will be corrected. The reported bias will be based on the benchmark mean values, rather than the mean plus two standard deviations.

QUESTION: 29

3.3.4.3 Verification Analysis

4. The reported results for the three experiments that were calculated differed from measurements by more than 2.3 to 2.4% (see comment in question 2 above). Is this computational error consistent with errors experienced in calculation of these experiments that have been performed by others? What are the reasons for the reported errors in the present calculations?

RESPONSE:

A reasonable bias of -3.6% was obtained by acceptable methods (see previous question) and applied to the computational results. The NUHOMS design is sub-critical as indicated by the resulting K_{eff} which is less than 0.92 after inclusion of all statistical and operational biases.

QUESTION: 30

3.3.7.1 Irradiated Fuel Handling and Storage

The temperature limits on fuel cladding in order to prevent its degradation in storage are based principally on tests in inert atmospheres. What criteria are applied in the design regarding storage atmosphere inside the DSC to prevent degradation and gross rupture per 10CFR72.72(h)?

RESPONSE:

NUHOMS System is designed for the storage of irradiated fuel in a helium atmosphere at temperatures well below those that would cause cladding failure. The criteria applied in the DSC design to assure inert atmosphere are the vacuum level prior to helium backfilling and the closure weld integrity.

QUESTION: 31

3.4 Classification of Structures, Components, and Systems

The safety and quality assurance classifications for each of the components of NUHOMS 0708 important to safety should be provided.

RESPONSE:

The utility must assign the quality assurance classification and requirements to each of these components in accordance with the utilities established quality assurance policies and practices. The quality assurance classification for each of these components should be included in the sites FSAR.

As listed in Table 3.3-1 the following items are those which NUTECH considers to be important to the safe operation of the NUHOMS System:

Cask

Canister

- Basket
- Spacer disk
- Support rods
- Lead plug
- End closure plates and closure welds
- Canister body

Concrete Module

- DSC support assembly
- Concrete Shielding

QUESTION: 32

4.0 INSTALLATION DESIGN

4.2.3.1 Dry Shielded Canister

1. It is stated the canister body consists of a 0.5 inch thick rolled and welded stainless steel plate. What is the maximum leakage rate for the longitudinal weld? What inspections and/or tests will be performed to assure that actual leakage is below this rate?

RESPONSE:

The longitudinal weld will be radiographed or ultrasonic tested to assure that the integrity of the weld is equal to the 0.5 inch thick stainless steel plate. Therefore, the leak rate of the longitudinal weld will be equal to that of the parent metal.

Under the NUHOMS system conditions the diffusion will be insignificant (see response to Question 1 of section 1.1).

QUESTION: 33

4.2.3.1 Dry Shielded Canister

2. The canister is partially coated with a dry film lubricant to reduce friction during loading. Will this film attract an insulating layer of dust or dirt which could interfere with heat transfer? How much of the canister will be coated with this material?

RESPONSE:

A dry film lubricant has a thin, hard, and dry finish which is bonded to the surface. The lubricant has a film thickness between 0.0003 and 0.0005 inches. The film does not attract dust or dirt and nor does dirt adhere to the finish, thus, will have no effect on the heat transfer.

For economic reasons, the dry film lubricant coating has been removed from the DSC design and transferred to the cask liner and T-section rails. By coating these components with a solid film lubricant the coefficient of friction between the sliding surfaces will only be between 0.04 and 0.08, far below the design value of 0.25.

QUESTION: 34

5.0 OPERATION SYSTEM

5.1.1.3 Cask Drying Process

1. When backfilling the canister with helium, the valves are closed when the pressure reaches 14.7 psia. What is the temperature of the helium when the valves are closed? How is the temperature measured or inferred? If the helium is not at the final equilibrium temperature, then the pressure will continue to rise as the gas heats up.

RESPONSE:

The procedures have been revised to include hydrostatic testing of the DSC and monitoring the pressure.

The following procedures will be incorporated in the Topical Report:

- Attach a self priming pump to valve #2 of the siphon line and drain more than 15 gallons from the DSC.
- Remove the self priming pump.
- Dry any water from top lead plug and DSC interface and then seal weld the upper stainless steel plate of the top lead plug to the canister body.
- Connect 0-75 psig pressure gauge to valve #2 on vent tube, and open valves #1 and #2.
- Connect demineralized water supply to intake side of hydro-pump and connect hose from discharge of hydro-pump to valve #2 of siphon tube.
- Open valves #1 and #2 on siphon tube.
- Activate hydro-pump and pressurize the DSC to 50 psig as read on pressure gauge.

RESPONSE: (Continued)

- Once internal pressure of the DSC has reached 50 psig close valves #1 and #2 on siphon tube and disengage hydro-pump.
- Monitor pressure for 10 minutes.
- After 10 minutes examine the primary closure weld (weld between top lead plug and DSC shell) for leaks. Continue monitoring pressure for throughout examination. If a leak is detected or if internal pressure drop is detected release pressure and repair weld.
- If no leaks are detected disconnect siphon hose from hydro pump discharge and connect to plant's low-level radioactive waste system. Open valves on siphon tubes, allowing pressure to drop to atmospheric pressure.
- Connect helium to DSC.
- Pressurize DSC with 1.5 atm of helium.
- Leak-sniff the weld for helium leaks.
- If a leak is found, repair weld.
- If no leak, release the pressure.
- Dry canister in accordance with the existing procedures #53 through # 58.
- Open valve #2 and allow the premeasured quantity of helium to flow into the DSC cavity.
- Close valve #1 and 2 on helium. Monitor pressure until it is stable.

QUESTION: 35

5.1.1.3 Cask Drying Process

2. What is the differential pressure across the canister wall when the helium sniffer leak test is performed?

RESPONSE:

The differential pressure across the canister wall when helium sniffer leak test is performed is 0.5 atm.

QUESTION: 36

5.2 2.1 Safety Features

What are the features of the spent fuel storage system which are important to safety that provide for safe operation under both normal and abnormal conditions? What, if any, are the limits selected for a commitment to action?

RESPONSE:

Section 5.2.2 of Regulatory Guide 3.48 is intended to describe the operation and safety features associated with the fuel handling system. The safety features associated with the fuel handling system are described in Section 5.2.1.2 of the Topical Report.

The safety features for the DSC and HSM are described in Sections 1.3.1.1 and 1.3.1.2 respectively. Chapter 10 lists the operating controls and limits for the safe operation of NUHOMS and specify commitments to action.

QUESTION: 37

5.3.2 Component/Equipment Spares

In the event that components are damaged during the life of the installation, what provision is made for installation of spare or alternative equipment to provide for continuity of safety under normal and off-normal conditions?

RESPONSE:

As the analysis has shown, the HSM protects the DSC during normal operation or from any credible accident. The only component of the NUHOMS system that can be damaged is the precast shielding blocks located on the roof of the HSM. The consequence of losing one or more shielding blocks is an increase in the skyshine scattered dose in the vicinity of the HSM.

In order to reduce the scattered dose, new shielding blocks could replace the damaged shielding blocks or portable shielding could be placed over the air outlets. Therefore, NUTECH recommends that spare shielding blocks be retained on site. The quantity is site specific and may depend on the number of modules in the installation, frequency of tornadoes, etc. The utility may wish to retain forms for casting shielding or plan to use existing portable shielding.

QUESTION: 38

7.2.1 Characterization of Sources

1. The design basis of the radiation sources for the shielding analysis is fuel assemblies with an average specific power of 37.5 MW(t)/MTHM, 33000 MWd/MTHM and five years post irradiation time. Based on these parameters a design basis neutron and gamma ray source strength have been calculated. Since the burnup parameters are average values, it may be that some combinations of seven fuel assemblies selected for loading into the DSC may have a higher source strength. Is the use of the mean values intended to imply that an arbitrary selection of fuel assemblies from a batch of assemblies satisfying the burnup parameters can be loaded into the DSC? If not, explain how limiting the source strength in any given canister to the design basis source strength will be accomplished in practice.

RESPONSE:

An arbitrary selection of fuel assemblies will <u>not</u> be loaded into the DSC. Selection and insertion into the DSC will be controlled by existing plant records and procedures. Section 5.1.1.1, Item 1 ensures that assemblies will be screened such that they satisfy the radiological requirements specified in Chapters 3 and 10. Furthermore, health physics surveys of the module are also specified after DSC insertion. Any, violation of design bases dose rates will require DSC removal or the use of portable shielding.

QUESTION: 39

7.2.1 Characterization of Sources

2. The flux-to-dose conversion factors shown in Figure 7.2-1 seem to be consistent with the multicollision tissue dose response function at energies greater than 1 MeV, but are a factor of 2 to 10 lower than that response function at lower neutron energies. What is the reference for the flux-to-dose conversion factors that were used?

RESPONSE:

Neutron flux-to-dose conversion factors were obtained from ANSI/ANS 6.1.1-1977 (N666) "American National Standard Neutron and Gamma-Ray Flux-to-Dose-Rate Factors."

Table 7.2-1 will be revised to reflect the correct response function for the 7.1 KeV through 0.41 KeV neutron groups.

QUESTION: 40

7.3.2 Shielding

1. Have verification analyses been performed tor the computer codes used in the shielding analysis (ORIGEN, ANISN, DOT-IV, QADMOD-G, and SKYSHINE-II)? Please discuss any shielding benchmark validations that have been performed.

RESPONSE:

Verification analysis has been performed on the subject computer codes by their respective computing vendors. They are, specifically:

ORIGEN2 - Babcock & Wilcox Computer Services
ANISN; DOT-IV-Boeing Computer Services
QADMOD-G; SKYSHINE II-UCCEL Corporation

Shield code verifications are not typically done on a case by case basis (such as for criticality codes). This is due in part to the reliance on health physic coverage during operation and the ability to make quick field modifications.

QUESTION: 41

7.3.2 Shielding

2. What was the concrete composition assumed in the shielding analysis? What variation in water content is considered over the service life of the HSM?

RESPONSE:

The concrete composition assumed in the shielding analysis is (by weight percent):

Hydrogen	0.5294 %
Oxygen	47.45 %
Sodium	1.629 %
Magnesium	0.2441 %
Aluminum	4.474 %
Silicon	30.02 %
Sulphur	0.1222 %
Potassium	1.833 %
Copper	12.53 %
Iron	1.181 %

The initial water content of the module concrete is expected to be 7.00%. Therefore, since a very conservative value was chosen for the water content, (4.2%, a 40% reduction) no allowance was made for variation in water content over the service life of the HSM.

QUESTION: 42

7.3.2 Shielding

3. What is the relative contribution of primary and secondary gamma rays for the gamma ray surface dose rate on the HSM wall or roof?

RESPONSE:

Secondary gamma-rays account for approximately 6% of the total gamma ray dose on the HSM wall or roof.

QUESTION: 43

7.3.2 Shielding

4. Page 7.3-9 third paragraph defers discussion of the HSM penetration calculation. The deferred discussion is not found later in the report. Please provide a discussion of the penetration calculation.

What was the quadrature order used in the DOT-IV calculation? Justify that the quadrature is adequate to accurately calculate streaming through the HSM air exhaust penetration.

RESPONSE:

a) The words "which is discussed later" will be deleted from the third paragraph on page 7.3-9 to avoid any future confusion.

Only one DOT-IV model was constructed to find the "axial" and "air exhaust" dose rates. Note that in Figure 7.3-7, "DOT-IV Model Axial and HSM Penetration Shielding Analysis," the model includes both axial points of interest as well as the air exhaust outlets.

The words "See Figure 7.3-7" will be added to the end of the first paragraph on page 7.3-14 to emphasize the DOT-IV modeling choice.

b) S_8 is the level of quadrature used in DOT-IV (48 solid angles in each hemispherical space). It was chosen in accordance with the guidelines given in ANSI/ANS-6.4-1977 as well as other technical literature, and sample problems provided by the computer vendor. A comparison between the degree of convergence obtained with S_8 and lower orders of quadrature was made during analysis for NUHOMS. On the basis of those comparisons, the additional computational expense of higher order quadrature did not offer significantly greater accuracy and was therefore unjustifiable. Furthermore, the quadrature used in the DOT sample problem for a penetration through a concrete shield was S_6.

OPERATION: 44

7.3.2 Shielding

5. The results in Table 7.3-2 indicate that the neutron attenuation through the HSM air exhaust penetration is greater than that for gamma rays. Can this result be explained?

RESPONSE:

The results in Table 7.3-2 do not indicate that the neutron attenuation is greater. The table below shows the resulting attenuation factors.

	Location	Neutron Dose Rate (mrem/hr)	Gamma Dose Rate (mrem/hr)	Gamma to Neutron Ratio
1)	Air Exhaust Outlet	1 ($4.17.10^{-4}$)(1)	11.5 ($6.05.10^{-7}$)	11.5
2)	HSM Roof	0.03 ($1.25.10^{-5}$)	8.2 ($4.32.10^{-7}$)	273
3)	Surface of the DSC (Midplane of fuel)	$2.4x10^{3}$ (-)	$1.9x10^{7}$ (-)	7920

1) Attenuation factor; dose rate in rows 1 & 2 divided by dose rate in row 3.

QUESTION: 45

7.3.2 Shielding

6. Were any measures taken to minimize ray effects in the DOT-IV calculations? Were ray effects evident in the results?

RESPONSE:

It is well known that ray effects associated with two-dimensional discrete ordinates codes are inevitable in most cases. NUTECH's results were also checked by examining flux variations from interval to interval. Large gradients in any direction (more than 50%) were not evident.

QUESTION: 46

7.3.2 Shielding

7. Has a verification analysis been performed for the application of the DOT-IV code to this type of shield penetration problem?

RESPONSE:

A verification run for streaming through a pipe chase (a similar penetration to the NUHOMS air outlet) was performed by Boeing Computer Services as part of their verification program.

QUESTION: 47

7.3.2 Shielding

8. Are the "Cask - DSC Annular Gap" dose rates reported in Table 7.3-2 averaged over the cask surface, or are they actually dose rates calculated in the gap?

RESPONSE:

The dose rates in Table 7.3-2 are the actual dose rates in the gap.

QUESTION: 48

7.3.2 Shielding

9. What was the angular quadrature used in the Cask - DSC annular gap calculation? Justify that the angular quadrature was fine enough to adequately model radiation transport through the gap. Were ray effects observed in the calculated fluxes? If the dose rate on the surface of the canister is plotted as a function of distance from the canister centerline, is streaming through the gap observed in the results?

RESPONSE:

The angular quadrature used was S_8. Due to the minor improvement in convergence noted between S_8 and lower order quadratures, an order higher than S_8 appeared unjustifiable in view of the increased computational costs. See the discussion in question 4 of section 7.3.2.

No significant ray effects were noticed.

Streaming through the annular gap is apparent in the results if the surface dose rate at the end of the canister is plotted as a function of distance from the canister centerline.

QUESTION: 49

7.3.2 Shielding

10. Is there any analysis or data to benchmark the validity of the QADMOD/albedo procedure used for estimating gamma ray penetration through the HSM air exhaust?

RESPONSE:

QADMOD, a modification of QAD, is an industry-standard point-kernel shielding code which is fully capable of determining incident dose rates on concrete surfaces within the penetration. The albedo method is recommended by ANSI/ANS - 6.4-1977, Section 8.4.4.2, and was applied in strict accordance with reference number 45 therein.

QUESTION: 50

7.3.2 Shielding

11. Were secondary gamma rays in the concrete considered in the vicinity of the air exhaust penetration?

RESPONSE:

Secondary gamma rays produced in the concrete were not considered in the albedo analysis of the air exhaust penetration. In view of the small neutron flux along the predominant reflecting surfaces, secondary gamma rays were considered to contribute a negligible amount to the overall gamma ray dose rate outside the penetration.

QUESTION: 51

7.3.2 Shielding

12. With reference to the proper axial positioning of the DSC within the HSM both during normal operation and in case of seismic event (refer to Question 6. under 8.1.1.5 and Question 6 under 8.2.3.2), it should be noted that there could be shielding implications.

RESPONSE:

A seismic retaining assembly has been added to the NUHOMS design. The seismic retaining assembly consists of a stopping block attached to the back end of the DSC support rails and seismic blocking device to be placed between the bottom cover plate and the door prior to closing the door. This retaining assembly will prevent the axial movement of the DSC. The Topical Report will be revised to incorporate the design of the seismic retaining assembly.

QUESTION: 52

7.4 Estimated On-Site Dose Assessment

1. Figure 7.4-1 indicated that the Total Dose drops slightly below the Scattered Dose at approximately 1000 ft. Is this a plotting error or a problem in the computer code?

RESPONSE:

There is a plotting error in Figure 7.4-1. This figure will be revised.

QUESTION: 53

7.4 Estimated On-Site Dose Assessment

2. The basis for the dose rates in Table 7.4-1 is not evident in the text. Please explain how the dose rate values were obtained.

RESPONSE:

The number of personnel and time span assigned to each of the operational steps in Figure 7.4-1 is based on experience with similar operations and engineering judgement. An average distance from the cask surface was assumed and used to estimate the ambient dose rate. The distances are intended to reflect time-averaged values for the given activity, and are taken from the torso to the cask surface nearest the operator.

The dose rate is obtained using the average distance and dose rate maps constructed from the results of NUTECH shielding calculations. Dose rates are typically conservative and do not assume that portable shielding could been used. NUTECH anticipates, however, that in actual practice on a site specific basis portable shielding and other normal plant health physics procedures will be employed wherever possible to keep total exposure even lower than indicated on Table 7.4-1.

QUESTION: 54

8.0 ANALYSIS OF DESIGN EVENTS

8.1.1 Normal Operation Structural Analysis

1. It is stated (Page 8.1-1) that "the mechanical properties of materials employed in the structural analysis of the NUHOMS system are presented in Table 8.1-2." This table only contains properties for stainless steel, carbon steel and lead. A number of other materials are used in the NUHOMS system including concrete, steel reinforcing, boral, etc. The properties for each of these materials should be included in Table 8.1-2 to insure that a consistent set of properties are used for all analyses and that appropriate consideration is given to the effect of temperature in each specific analysis.

RESPONSE:

Table 8.1-2 will be revised to include the mechanical properties of concrete, reinforcing steel and boral at various temperatures.

QUESTION: 55

8.1.1 Normal Operation Structural Analysis

2. There is lack of experience on long term storage of spent fuel horizontally. Please address the effects on the fuel of its horizontal storage over long times in the HSM and any related effects on its retrievability.

RESPONSE:

Although there is lack of experience on long term storage of spent fuel horizontally, there is considerable experience on the shipment of the fuel in the horizontal position. A summary of shipping experiences world wide is listed in the document "Technical Basis for Storage of Zircaloy-Clad Spent Fuel in Inert Gases" by Battelle, and is reproduced here.

"Approximately 1000 shipments (~2000 tU) of LWR fuel have been transported dry in Europe and from Japan to Europe; these shipments have included ~4550 BWR and PWR assemblies. Within the United States there have been ~1500 LWR fuel shipments (900 tU; ~4100 fuel assemblies). During sea shipments the fuel remains horizontal for up 2 to 3 months, sometimes at cladding temperatures estimated at up to 385°C. Thus, the fuel resides horizontally for significant periods at conditions approaching those in dry storage without evidence of significant damage. If the fuel is not damaged during emplacement and retrieval, horizontal storage does not appear to offer a threat to cladding integrity."

It is worth noting that the environment for shipping fuel, given the transportation shock loadings, vibrations etc., is much harsher than the passive environment under dry storage. Also, on theoretical grounds, studies have shown cladding creep is acceptable with regard to retrievability, at temperatures below 385°C over the time spans associated with fuel heat decay. The Battelle report refers to the document: "Zry Post-Pile Creep: Experimental Procedure, Test Samples and First Results", by Peehs, M, et,al. 1983, where by the studies on the cladding creep is reported. From the discussion above it can reasonably be concluded that the cladding behavior in a horizontal position will not differ significantly than in the vertical direction.

QUESTION: 56

8.1.1.1 Normal Operation Loads

1. What is the basis for the assumptions of 25% fission gas release in the design internal pressure calculations?

RESPONSE:

The selection of a 25% fission gas release fraction is based on an EPRI fuel performance data base. The fraction represents a value substantially higher than that normally seen in LWR fuel operation. The study of fission gas release fraction is of some importance to the nuclear power industry since large release fractions can have a deleterious effect on fuel performance. As part of this study, EPRI has developed a data base of fission gas release measurements for 124 well-characterized fuel rods.* Some 102 of these rods were irradiated in domestic LWRs. These rods encompass a large range of linear heat ratings, burnups, enrichments fuel pellet densities and operating histories. None of these samples exceeds a 25% release fraction. Most release fractions are between 0.33% and 12%.

* Reference: E. Rumble, J. Simpson, S. Lee and A. Woodis, "The EPRI Fuel Performance Data Base; General Description", EPRI NP-1489, October 1980.

QUESTION: 57

8.1.1.1 Normal Operation Loads

2. On page 8.1-5, the normal average canister gas temperature is stated to be 450°F. However, Table 8.1-13 gives an average helium temperature of 429°F. at 125°F. HSM inlet temperature. Which value is correct?

RESPONSE:

At 125°F ambient temperature the helium temperature is 429°F as shown in Table 8.1-13. Page 8.1-5 will be revised.

QUESTION: 58

8.1.1.1 Normal Operations Loads

3. The temperature distribution for the spacer disc (Figure 8.1-2) shows that the temperature at the point of closest approach between the canister and the guide tube is lower than its neighboring points. Is this correct? Please explain.

RESPONSE:

Those locations have incorrect temperatures. The figure will be revised. However, the error will have a negligible effect on the results of the analysis, because of the small temperature difference between the correct temperature value and the temperature shown in the figure, and the maximum temperature of the spacer disk.

QUESTION: 59

8.1.1.1 Normal Operation Loads

4. Please explain how the three steady-state temperature distributions were used to determine the effects of thermal cycling. On page 8.2-51, the heat up rate (100°C temperature change) of the insulated loaded DSC is given as 13 hours. Since this is about one-half of a diurnal temperature cycle, have such cycles been included in the cyclic fatigue analysis? If not, how would their inclusion modify the results?

RESPONSE:

The heat up rates on page 8.2-51 are for an insulated loaded DSC. These heat up rates were used to determine the temperature of various components when the air inlets and outlets are blocked, an accident condition.

The fatigue analysis due to seasonal thermal cycling is explained on pages 8.2-57 and 8.2-60. This analysis is based on the conservative assumption that the range of alternating thermal stress is from zero to the maximum normal steady state temperature of the DSC (i.e. 228°F at 70°F ambient). This range is greater than the range between the two extreme ambient temperature (132°F at -40°F ambient and 278°F at 125°F ambient) and as such envelops this condition.

QUESTION: 60

8.1.1.1 Normal Operation Loads

5. On page 8.1-5 the density of normal concrete is given as 150 pounds per cubic foot. This value differs from that shown in Tables 8.1-4 and 8.1-4. Please clarify.

RESPONSE:

The unit weight of concrete varies between 140 and 150 lb/ft^3. A 10 lb. variance in the unit weight of concrete is not unusual. The more conservative unit weight of 150 lbs/ft^3 was used in the structural analysis such as dead weight. However, in shielding analysis a unit weight of 145 lbs/ft^3 was assumed. In the site specific application a minimum unit weight 145 lb/ft^3 will be specified.

QUESTION: 61

8.1.1.1 Normal Operation Loads

6. Equations 8.1-9 and 8.1-10 on page 8.1-20 have missing terms. If the equations in the Topical Report were used, the results may be incorrect. Please clarify.

RESPONSE:

Equation 8.1-9 and 8.1-10 on page 8.1-20 are incorrectly typed. The analysis contained missing ν and λ terms. Page 8.1-20 will be revised.

QUESTION: 62

8.1.1.1 Normal Operation Loads

7. The modulus of elasticity is incorrectly taken as 27.0×10^6 psi instead of 26.6×10^6 psi for the design basis temperature of 400°F. Please correct.

RESPONSE:

The Young's Modulus value of 27.0×10^6 will be revised to 26.6×10^6 psi.

QUESTION: 63

8.1.1.1 Normal Operation Loads

8. The temperature distribution within the DSC depends upon the azimuthal orientation of the DSC within the HSM. That is, the analysis assumes that three (3) assemblies are centered on a vertical line passing through the center of the DSC. How will this orientation be assured during loading?

RESPONSE:

It is highly unlikely that any variation in the orientation of the DSC within the HSM will cause any significant differences in the internal temperature distribution. However, to assure that the physical orientation is identical to that of the thermal model, markings will be placed on the top cover plate that will indicate the azimuthal orientation of the canister. The DSC will be loaded into the cask in the proper orientation.

QUESTION: 64

8.1.1.2 Dry Shielded Canister Loads Analysis

1. Thermal variations in the circumferential and axial direction of the canister will result in thermal stresses due to self constraint by the colder canister ends. On page 8.1-22 the statement is made that, "Also, the thermal variation in the circumference and longitudinal directions of the shell are not considered significant since in the unrestrained condition the shell will expand radially and longitudinally to an equilibrium state." NUTECH should show what the overall deflected shape is in the axial direction, and the deflected shapes of a cross section at the end and the center of the DSC. NUTECH should show what the ASME stress intensities are for the following locations on the DSC: (1) top and (2) bottom elements of shell at top cover plate edge (3) top and (4) bottom elements of shell at center section; (5) top and (6) bottom elements of top cover plate at shell edge. Please include effects of discontinuity between shell and top cover plate.

RESPONSE:

The temperature along the length of the DSC does not vary significantly (± 20°F). This temperature change is not as great as the thermal variance that occurs around the circumference of the DSC shell. As shown in Figure 8.1-1, the temperature of the DSC shell varies from 229°F to 285°F. Thermal stresses due to this variance were evaluated by means of finite element analysis. The maximum thermal stress intensity of 11.24 ksi was determined which occurred at the DSC and T-rail interface. This stress is far lower than the thermal stress of the DSC shell reported in Table 8.1-7, page 8.1-15 of the Topical Report. The stress values reported in Table 8.1-7 is located at the region of the DSC and spacer disk interface and is based on the differential thermal expansion of the spacer disk and the DSC shell. Based on the above observation the thermal stresses at other locations requested are envoloped by those reported in Table 8.1-7.

QUESTION: 65

8.1.1.2 Dry Shielded Canister Loads Analysis

2. The drawings provided (ADV001.0204 sheets 1 and 2) do not provide enough dimensions to be able to determine what minimum gaps might exist between the boral baskets and the top lead plug. Please supply actual shop drawings instead of conceptual design drawings. This relates to p. 8.1-22 and 8.1-24.

RESPONSE:

The drawings provided are neither conceptual nor shop drawings. They are design drawings. Clearances will be added to the drawings.

QUESTION: 66

8.1.1.3 Dry Shielded Canister Internal Basket Loads Analysis

Please provide information showing where the 0.75 inch irradiation growth of the fuel assembly came from. The drawings do not permit a verification of calculations of this section of the topical report.

RESPONSE:

The irradiation growth of 0.75 inches was based on data obtained from the following report:

Examination of High Burnup fuel at the
H. B. Robinson Reactor End of Cycle 8
Report No. XNNF8317
Exxon Nuclear, Inc.

QUESTION: 67

8.1.1.4 DSC Support Assembly Loads Analysis

The first sentence of the Thermal Analysis section p. 8.1-32 is acceptable if an assembly procedure specifying the torque of the nuts is included.

RESPONSE:

As specified in Table 3, p. 5-214 of the 8th Edition of the AISC Steel Manual the minimum tension for a 3/4 inch diameter bolt is 28 kips. This corresponds to a tightening torque on the nuts of 4200 inch-lb. The amount of friction force created by the tensioning of the bolt is 21 kip. However this force can easily be overcomed by the thermal expansion force created temporarily by the heat up of the rail during normal operating condition.

QUESTION: 68

8.1.1.5 Horizontal Storage Module Loads Analysis

1. A reference in the third paragraph of this section (page 8.1-35) is made to NUREG 0880. Shouldn't this reference to be NUREG 0800?

RESPONSE:

The reference should be NUREG 0800. This page will be revised.

QUESTION: 69

8.1.1.5 Horizontal Storage Module Loads Analysis

2. Table 8.1-10 (Page 8.1-38) includes values for the ultimate moment and shear capacity of the HSM. The value computed for the ultimate moment capacity, 4052.0 in-kips, is given on Page 8.1-49. However, no calculation is presented for the ultimate shear value, 59.2 kips. The details of this calculation should be included.

RESPONSE:

The nominal shear capacity was based on equation 11-28 in American Concrete Institute (ACI) 349-80:

$$V_c = 2\sqrt{f'_c}\ b_w d \qquad (11\text{-}28)$$

The nominal shear value calculation will be incorporated into the Topical Report.

QUESTION: 70

8.1.1.5 Horizontal Storage Module Loads Analysis

3. Figure 8.1-11 (Page 8.1-39) includes moment and force loads that are applied to the reinforced concrete corbel that supports the DSC support Assembly. Calculations should be provided for the stresses in the corbel due to these loads and for the ultimate strength capacity of the corbel.

RESPONSE:

Figure 8.1-11 shows the dead and live loading at the centerline of the module walls, not the corbel centerline. Table 8.2-12 show the maximum end loads (at corbel) for each load combination. As stated on page 8.2-63 the corbel, bearing plate and bolts were designed for these load combinations. Additionally, for the corbel, design loads were multiplied by 1.7 to envelope all load combinations specified in ACI 349-80.

Design and analysis were performed using the criteria of Section 11.9 of ACI 349-80 and the recommendations of Chapter 5 of Wang & Salmon (Reinforced Concrete Design, Third Edition). The nominal shear strength, V_n using equation (11-31) of ACI 349-80 yields 29.4 kips. Since the factored shear load is only 17k the corbel is adequate per ACI 349-80. Additional corbel reinforcement and welded plates were added to allow the direct transfer of the horizontal forces to the tension reinforcement per suggested practices in Wang. Therefore, the concrete corbel is designed to take all DSC support assembly load combinations per ACI 349-80.

Table 8.2-12 will be revised to incorporate the capacity of the corbel, bearing pads and the bolts at both normal operating and accident condition.

QUESTION: 71

8.1.1.5 Horizontal Storage Module Loads Analysis

4. Please state your interpretation of ACI 349-80 acceptance criteria for concrete temperatures. An air inlet temperature of 70°F is used to evaluate normal operating temperatures. Please relate this number to meteorological information which could be used to determine site acceptability.

RESPONSE:

ACI 349-80 Appendix A, Section A.4 states for normal operation or any long term period the concrete temperature shall be limited to 150°F except at local areas, where it is limited to 200°F. For accident conditions or periods of short time duration, the temperature may not exceed 350°F except at local areas, where it is limited to 650°F. Section A.4.3 of the code allows for even higher temperatures than those specified if tests are performed to evaluate the loss of strength due to sustained exposure to elevated temperatures. On page 8.1-44 of the Topical Report a number of references are listed which show concrete strength is not effected by temperature below 212°F for both short and long term duration.

Although temperature does impact the mechanical properties of the concrete, the critical factor to consider is the temperature gradient in the concrete and its associated stresses. As shown in Table 8.1-12 the maximum temperature gradient in the concrete occurs at normal ambient temperatures of 70°F, which produces an enveloping thermal stress in the concrete walls & slabs.

QUESTION: 72

8.1.1.5 Horizontal Storage Module Loads Analysis

5. The analysis of local concrete temperatures does not include conduction through the thermal shield support bolts or through the support rail to the corbels. How will consideration of this direct heat transfer path affect local concrete temperatures and satisfaction of ACI 349-80 acceptance criteria? Also, how will concrete thermal conductivity be affected by thermal cycling over the license period, and by the presence of rebar in the concrete?

RESPONSE:

The heat shield support bolt located at the mid-section of the roof slab has been removed, Figure 4.2-6 will be revised to incorporate this change.

Furthermore assuming that the heat shield support bolts or corbels do provide a direct heat transfer path, the local concrete temperatures, under normal operating conditions, do not exceed the acceptable criteria established in ACI 349-80. The remaining heat shield support bolts are located at the extreme ends of the heat shield. HEATING6 analysis shows that the temperatures in these areas does not exceed 170°F. Additional heat transfer analysis shows that under normal operating temperatures, the temperature of the DSC support assembly is less than 170°F. Conservatively, assuming that the bolts or corbels are at the same temperature as the base metal and that the local temperature of the concrete is at the same temperature as the bolts or corbels, the local temperature of the concrete is below the criteria in ACI 349-80.

Thermal cycling of the concrete over the license period of the HSM has been discussed in response to question 2 of Section 1.2.2.

QUESTION: 73

8.1.1.5 Horizontal Storage Module Loads Analysis

6. If the end of the DSC were to contact the concrete wall, a concrete temperature of the same magnitude as the calculated DSC temperatures would result. What is the clearance between the end of the DSC and the concrete wall and what is the concrete temperature adjacent to the end of the DSC?

RESPONSE:

The clearance between the end of the DSC and the concrete wall is 3 inches.

Additional heat transfer analysis indicates that the average concrete temperature adjacent to the end of the DSC is approximately 70°F lower than the average surface temperature of the DSC end.

The concrete temperature for the end walls of the HSM is not as critical as the side walls and roof slab, since the frame action in the transverse direction of the HSM is considered the main structural resisting system. Also, the air outlet opening at the ends of the HSM roof provides some freedom for the thermal movement of the end walls.

QUESTION: 74

8.1.2 Off-Normal Events

Failure of the supports for the thermal radiation shield (due to seismic events, corrosion, etc.) has not been addressed. Please justify that this event is not feasible, or provide an analysis of the consequences. How would such as failure be detected?

RESPONSE:

The heat shield is designed to withstand all applicable loads and environmental conditions during the lifetime of the horizontal storage module. The heat shield will experience only dead weight and seismic loads. Thermal loads will not be experienced since oversized holes will allow unrestrained thermal expansion. The heat shield will be galvanized to prevent corrosion. The shield and the embedded anchor bolts were analyzed for maximum dead weight plus seismic loadings. Conservatively, the heat shield was treated as a simply supported beam with a uniform loading. A maximum bending stress of 12.43 ksi was calculated. Axial and shear stresses were negligible. The tensile and shear stress of 1.08 ksi and 0.53 ksi were calculated respectively for the anchor bolts by conservative assumptions. A bearing stress of 1.68 ksi was calculated for the anchor bolt/heat shield contact point. Clearly then, these minimal stresses show that the radiation shield is capable of withstanding any postulated loading. Therefore, no failure detection system is necessary.

QUESTION: 75

8.1.2.2 Blockage of the Horizontal Storage Module Inlet - Cause of Event and Detection

1. Air flow through the HSM with both inlets blocked appears to be a random process with zero mean value. Please provide experimental confirmation based on scaled or appropriate data to demonstrate the assumed magnitude of flow for this case.

RESPONSE:

The air flow is not a zero mean, random process. The 7 kw of heat produced by the fuel will heat the air and cause a significant driving force to push the air out of the HSM. As the air is forced out, the pressure in the HSM will decrease and air from the outside will be drawn in. Exact flow paths will depend on existing meterological conditions, but because of the constant heat source, the air will flow.

As part of the demonstration program, extensive testing will be performed on the first prototype module to be built at Carolina Power and Light. Evaluation of the airflow through the HSM when both air inlets are blocked will be included in the electrical heater testing program.

QUESTION: 76

8.1.2.2 Blockage of the Horizontal Storage Module Inlet - Cause of Event and Detection

2. Please clarify the pressure given on page 8.1-60. The values are not consistent. According to the ASME text booklet "SI Units in Heat Transfer" 1st Ed., 14.504 psi - 1 bar. Also, refer to subsequent units conversions between psi and bar.

RESPONSE:

The pressure given on page 8.1-60 will be revised.

QUESTION: 77

8.1.3.1 Thermal-Hydraulics of the Horizontal Storage Module Principles of HSM Cooling System

1. Reference 8.44 referred to here is not given in the reference list.

RESPONSE:

Reference 8.44 was inadvertently omitted. Reference 8.44 is

I.E. Idel'Chik, Handbook of Hydraulic Resistance, Coefficients of Local Resistance and of Friction, the U.S. Atomic Energy Commission and the National Science Foundation, Washington, D.C., 1960.

This reference will be included in the revision of the Topical Report.

QUESTION: 78

8.1.3.1 Thermal-Hydraulics of the Horizontal Storage Module Principles of HSM Cooling System

2. The thermal analysis is based on an assumed axial peaking factor of 1.08. This is an additional limiting design parameter which is not cited in Table 3.1-1. If it is not intended to impose this limit on stored fuel, please justify its conservatism for proposed fuel types, burnup histories, etc.

RESPONSE:

In most heat transfer analysis of decay heat during dry storage the heat generation rate of a fuel assembly is assumed to be uniformly distributed along the active fuel length. However, in NUTECH's analysis the axial peaking factor of 1.08 was conservatively applied to the uniform heat generation rate in order to determine the worst case temperature distribution in a two dimensional cross section of the DSC and HSM. Even with the conservatism, the maximum fuel cladding temperature was calculated to be 338°C, under the worst ambient temperature of 125°F. This maximum cladding temperature is significantly lower than the acceptable limiting fuel rod temperature.

As stated in Section 10.3.1.1, the decay power per fuel assembly is limited to 1 kw.

QUESTION: 79

8.1.3.1 Thermal-Hydraulics of the Horizontal Storage Module Principles of HSM Cooling System

3. Equations 8.1-37 through 8.1-40 are applicable within restricted domains of L^3 ΔT. Please show that these restrictions are satisfied.

RESPONSE:

Equations 8.1-37, 8.1-39, and 8.1-40 are valid for flow in the turbulent range. As the table below indicates the flow is in the turbulent range. Gr.Pr falls between 10^8 and 10^{12}. The ΔT is based on the average steady state temperature of the particular surface and the average air temperature in the region.

Gr.Pr for HSM
for Various Ambient Temperatures

Flow Region	Ambient Temperature -40°F	70°F	125°F
Canister Circumference	2.8×10^{10}	2.53×10^{10}	2.38×10^{10}
Floor	2.3×10^{9}	2.68×10^{9}	2.92×10^{9}
Wall	1.83×10^{10}	2.0×10^{10}	2.29×10^{10}

Therefore, equations listed above are valid over any L^3 ΔT domain.

QUESTION: 80

8.1.3.1 Thermal-Hydraulics of the Horizontal Storage Module Principles of HSM Cooling System

4. What levels of solar radiation were considered in the heat transfer analysis? Of particular concern is the levels associated with the hottest days (Tair=125°F).

RESPONSE:

The following equivalent solar heat flux were included in the HSM thermal model.

Ambient Temperature (°F)	Solar Heat Flux ($BTU/hr.ft^2$)
-40	23.5(1)
70	93.8(2)
125	187.6(3)

(I) 1/12 of the half day solar heat gain for 40 degree north latitude on December 21.

(2) 1/12 of the half day solar heat gain for 40 degree north latitude on June 21.

(3) Twice the solar heat flux for 70°F case.

QUESTION: 81

8.1.3.1 Thermal-Hydraulics of the Horizontal Storage Module Principles of HSM Cooling System

5. Page 8.1-69 gives the maximum concrete ceiling temperature as 244°F, whereas Table 8.1-12 gives 249°F. This analysis does not consider direct conduction through the supports to the concrete. Is the severe summer condition considered to be an off-normal or transient condition? If so, what is the limiting ambient condition to be used for determination of whether acceptance criteria on concrete temperature are met? The value of 70°F is quite low for a limiting ambient condition.

RESPONSE:

The maximum concrete ceiling temperature is 249°F page 8.1-69 will be revised to read 249°F.

The question of "Direct Conduction through the Supports" is responded in Section 8.1.1.5, question 5.

The severe summer condition is considered to be a transient condition, since the time required for the concrete temperature to reach steady state is by far greater than the short period associated with extreme 125°F ambient temperature.

The selection of 70°F as the limiting ambient temperature is based on the fact that the thermal gradient through concrete thickness is greater for the 70°F ambient temperature than the other ambient extremes. Comparison of cases 1 through 3 of Table 8.1-12 will indicate this fact.

Since the concrete thermal stress is maximized by the application of maximum thermal gradient, the selection of 70°F ambient condition is considered appropriate.

Furthermore, because of the long time constants associated with the thermal masses of the HSM and DSC, they will, over a daily bases, be at temperatures which are more representative of the 24 hour average air temperature than any ± 30 to 40°F daily temperature swings. Thus, again, 70°F is a good value of the normal operating ambient temperature.

QUESTION: 82

8.1.3.3 Thermal-Hydraulic Analysis of the Canister Inside the Transfer Cask Model

1. In equation 8.1-40, the emissivity of the stainless steel transfer cask exterior is taken as 0.80, whereas a value of 0.587 was used for stainless steel surfaces within the DSC (page 8.1-74) and transfer cask (Equation 8.1-43). Please justify this use of different values for the emissivity.

RESPONSE:

The thermal-hydraulic analysis of the canister inside the transfer cask assumed that the DSC was seated within the cavity of the GE IF-300 shipping cask. The emissivity value, 0.80, for the stainless steel exterior of the transfer cask, corresponds to the effective emissivity for the corrugated surface of the GE IF-300 shipping cask, 0.83 rounded down. The effective emissivity is reported on page 6-41 of the GE IF-300 Shipping Cask Consolidated Safety Analysis Report.

QUESTION: 83

8.1.3.3 Thermal-Hydraulic Analysis of the Canister Inside the Transfer Cask Model

2. What is the sensitivity of the calculated results to variation of input parameters, e.g., emissivity, axial peaking factor, apparent thermal conductivity, decay heat, etc.? How is the margin of safety to limiting conditions established?

RESPONSE:

The purpose of the reported analysis is to show that the safe operation of the system is not jeopardized under various operating scenarios. The margin of safety was established through conservatisms assumed in the calculations and the extreme conditions which were assumed.

QUESTION: 84

8.1.5 Design Basis Internal Pressure Loads

Please describe any hydrostatic testing to be performed to assure integrity of the DSC. Has NUTECH considered pressurizing the loaded DSC with helium as a test of DSC integrity? In such a test how would the test pressure relate to the design pressure and the accident pressure discussed in Section 8.2.9?

RESPONSE:

As stated in response to Question 5.1.1.3 the DSC will be hydrostatically tested in accordance with the requirements of ASME, Section III, Subarticle NB-6220. The test will be conducted at a pressure of 1.25 the accident pressure, discussed in Section 8.2.9. The hydrostatic test should be more than adequate in assuring the DSC integrity.

QUESTION: 85

8.2.2.2 Accident Analysis

1. The coefficient of friction between a single, unanchored module is stated to be 1.0 on Page 8.2-7. The ACI 349-80 code states in Sections 11.7.5 and 11.7.9 that the coefficient of friction shall be 1.0 if concrete is placed against hardened concrete and the interface between the concrete surfaces is clean, free of laitance and "intentionally roughened to a full amplitude of approximately 1/4 inch." The ACI 318-83 code states in Section 11.7.4.3 that the coefficient of friction shall be 0.6L for the case wherein concrete is placed against hardened concrete not intentionally roughened (:L: is this relation 1.0 for normal weight concrete). Shouldn't coefficient of friction of no greater than 0.6 be used between the NUHOMS system and the supporting concrete pad, especially since no specific mention is made of the need for roughening the surface of the concrete pad under the NUHOMS system? (See question on Section 3.2.3.2).

RESPONSE:

As stated in response to question 3.2.3.2, the coefficient of friction will be changed from 1.0 to 0.6. The only area effected by this change is the sliding of the single HSM under various accident loads. A shear key type of connection located at the module walls or a tie-down system will be specified.

QUESTION: 86

8.2.2.2 Accident Analysis

2. It is noted on Page 8.2-13 that a single HSM will require tie downs for resistance against overturning and sliding under the action of a massive missile impact (i.e., a 3,976 lb automobile). It is further noted on this page that the NUHOMS 0708 concept, which has 8 modules either poured in place or pre-cast, will not slide under the postulated impact. Since it is understood that actual, site specific configurations for the NUHOMS system may have any number of modules, wouldn't it be appropriate to either require tie downs, to permanently anchor the NUHOMS system to its supporting concrete pad or to set the HSM in a key-way embedded into the pad rather than rely on the use of friction to restrain the HMS from sliding on the pad and potentially exposing contaminated surfaces?

RESPONSE:

As stated in response to question 3.2.3.2, a shear key type of connection located at the module walls or a tie-down system will be specified.

QUESTION: 87

8.2.3.2 Accident Analysis

1. The values of E on pages 8.2-14 and 8.2-16 are incorrectly taken at room temperature. Please use the value of E at the maximum calculated temperature.

RESPONSE:

The values of E on pages 8.2-14 and 8.2-16 of the report will be changed from 27.0 E6 to 26.6 E6.

QUESTION: 88

8.2.3.2 Accident Analysis

2. The calculations in this section assume the maximum vertical earthquake acceleration to be 0.1g. As noted in Question 3.2.3.2, this acceleration should be increased to at least 0.17g. Each of the calculations in Section 8.2.3.2 that are based on the maximum vertical acceleration should be redone to reflect this increased acceleration and each reference to a vertical acceleration of 0.1g should be changed to 0.17g.

RESPONSE:

As stated in response to Question 3.2.3.1-2, the vertical ground acceleration will be increased to 0.17. All associated analyses will be revised to incorporate this change.

QUESTION: 89

8.2.3.2 Accident Analysis

3. The term V_w in Equation 8.2-20 (Page 8.2-19) only includes the volume of one wall of the HSM whereas the term V_r includes the entire weight of the roof. Furthermore, the value for I (74,088 in^4) given on Page 8.2-20 represents the moment of inertia of only one wall. Shouldn't the calculation for mass presented in Equation 8.2-20 include only one-half of the mass of the roof? Also, shouldn't this calculation include the effect of the DSC and its support?

RESPONSE:

As stated on page 8.2-19 of the Topical Report the mass was taken as the entire top slab plus one half of the side walls. Therefore, the term V_w is the volume of one half of two walls or one total wall. The mass of the lower half portion of both walls is assumed to be reacted at ground level. This approach of lumping mass based on tributary area is commonly practiced throughout the industry. Additionally the moment of inertia is based on one wall. Equation 8.2-21, however, contains a factor of 2 to account for the stiffness of both walls. Hence, the module frequency calculations are correct as shown on pages 8.2-19 and 8.2-20.

The effects of the DSC and the support assembly were omitted since they act below the halfway point on the module walls and will not have a significant effect on the results. The mass of the DSC and support assembly per 12 inch section of the HSM is 3.9 $\frac{lb.\ s^2}{in}$. If this mass were conservatively lumped at the HSM roof the resulting HSM frequency would be 35.9 Hz. This conservative value is still beyond the control point A of 33 Hz shown in Tables 1 and 2 of NRC Regulatory Guide 1.60. Therefore, the maximum amplification factor of 1.0 is still valid for the analysis.

QUESTION: 90

8.2.3.2 Accident Analysis

4. Shouldn't the parameter V_u in Table 8.2-6 (page 8.2-21) actually be labeled "M_u" as in Table 8.2-3?

RESPONSE:

The term V_u in Table 8.2-6 will be replaced by the correct term M_u in the next revision of the Topical Report.

QUESTION: 91

8.2.3.2 Accident Analysis

5. No mention is made in the sub-sections entitled "DSC Stress Analysis" (Page 8.2-16) and "Horizontal Seismic" (Page 8.2-24) of combining horizontal seismic loads from two directions. Seismic loads from two horizontal directions and the vertical direction should be combined unless a statement can be made that loads from a particular direction can be considered to be negligible (i.e., as was done on page 8.2-20).

RESPONSE:

The DSC is retained axially for a seismic event as described in the response to question 12, Section 7.3.2. Consequently, an axial membrane stress will be experienced by the DSC shell. Assuming an equal stress distribution throughout the DSC yields a stress of 0.19 ksi. Compared to the local bending stress of 9.58 ksi calculated by a horizontal loading perpendicular to the DSC, this axial stress is negligible. Additionally, no increase in combined stress will occur when summed with the other horizontal stress using the SRSS method. Therefore, stress due to an axial horizontal acceleration along the DSC shell is minimal and can be considered negligible. A statement of this effect will be added on page 8.2-24 of the Topical Report.

For the support assembly seismic evaluation the stress due to horizontal acceleration in the axial direction can be calculated directly by factoring the results from the friction load case. The maximum bending and shear stress in the W8 x 28 are 0.56 ksi and 0.68 ksi, respectively. The maximum bending and shear stress in the W4 x 33.5 are 0.76 ksi and 0.34 ksi respectively. These values will be combined by the SRSS method with the other horizontal stress and then added absolutely with the vertical seismic stress. This revised value will be included in the subsequent load combination reported in Table 8.2-11. The seismic load combinations in Table 8.2-11 will be revised to reflect the results listed below.

Component	Load Combination	Calculated Stress (ksi) Axial	Bending	Shear
W 8 x 28	$DW_S + DW_C + SSE$	0.40	8.19	5.08
WT4 x 33.5	$DW_S + DW_C + SSE$	0.77	17.37	5.01

QUESTION: 92

8.2.3.2 Accident Analysis

6. As a follow-on to the above question, it is noted that no mention is made of the possibility of the cask sliding longitudinally along the rails when loaded seismically. If such a possibility exists, could some part of the HSM structure be impacted by the DSC (e.g., the door), resulting in damage to either the HSM or the grapple on the end of the DSC? If the DSC cannot slide, shouldn't some sort of load be applied to the rails, and consequently to the DSC support assembly?

RESPONSE:

As described in the response to question 12, Section 7.3.2 a seismic retaining assembly will be installed prior to closing the HSM door. This assembly will prevent longitudinal sliding of the DSC along the rails during a seismic event. Therefore, no possibility of impact damage is present.

As described in the answer to question 5, Section 8.2.3.2 the DSC support assembly will experience seismic axial loads along the WT 4x33.5 rails. Consequently, the Topical Report will be revised to include stresses caused by this loading. See answer to question 5, Section 8.2.3.2 for revised stresses due to this additional horizontal seismic loading.

QUESTION: 93

8.2.4.2 Accident Analysis

1. Reference to Table 3.2-2 for flood loadings is incorrect (Page 8.2-24). Also reference to Table 3.2 is incorrect (Page 8.2-28).

RESPONSE:

The reference to Table 3.2-2 on page 8.2-24 and Table 3.2 on page 8.2-28 will be changed to Table 3.2-3.

QUESTION: 94

8.2.4.2 Accident Analysis

2. A flood level which caused the bottom portion of the DSC to be in contact with water while the upper portion remained in air could cause considerable thermal stress in the canister. Have these loadings been included with the pressure loadings?

RESPONSE:

Since the source of flooding and its various parameters, such as flood level, velocity, temperature, etc. are necessarily site specific, no attempts were made to analyze the DSC for any particular flood condition. Instead, a capacity analysis based on the external pressurization of the DSC, as the main loading criteria, was performed and subsequent maximum flood water level were established. Any site specific flooding condition which can not be enveloped by this loading criteria needs to be addressed in the site's Safety Analysis Report.

Nevertheless, the DSC thermal stress under a half flooded condition can be conservatively estimated by utilizing the results of thermal analysis performed in response to question 8.1.1.2. This thermal analysis was based on a circumferential temperature variance of 55°F for normal operating condition. For a half flooded condition, if the water temperature is assumed at 70°F and at the same time the hottest DSC temperature at upper DSC region remains the same at 283°F, a circumferential temperature variance of 213°F if obtained. By assuming other parameters in the analysis remains the same for both conditions, then an increase of 3.84 times the thermal stress associated with normal operating condition can be anticipated. The maximum stress for normal operating condition is 11.24 ksi, therefore for half flooded condition the stress will be 43.53 ksi which is still less than the level A stress allowable of 56.10 ksi.

This level of stress which was derived by overly conservative assumptions indicates that any site specific flood level can easily be tolerated by the DSC.

QUESTION: 95

8.2.5.2 Accident Analysis

1. The discussion on page 8.2-29 implies that the decelerations used by NUTECH were obtained by multiplying actual drop-test data (obtained by ORNL) by one-sixth to reflect a 5 foot drop height instead of a 30 foot drop height. Examination of the GE Consolidated Safety Analysis Report of the IF-300 shipping cask reveals that NUTECH used decelerations which the Stearns-Rogers Company calculated using a dynamic analysis program, "Dyrec". Since the Stearns-Rogers results envelope the ORNL results, this is a conservative approach. However NUTECH should revise the discussion to reflect their actual process. Also NUTECH should reference the data by appendix.

RESPONSE:

The discussion on page 8.2-29 will be revised to reflect the actual process. Additionally, data will be referenced by appendix.

QUESTION: 96

8.2.5.2 Accident Analysis

2. A second related question concerning drop decelerations has to do with the data in Appendix V2 of the GE document NEDO-10084-3. Why did NUTECH not use the deceleration for top end vertical drop as reported in this appendix? It is more conservative than the Stearns-Rogers data.

RESPONSE:

GE document NEDO-10084-3, Appendix V2, September 1984, was reviewed for possible higher vertical drop deceleration. This document presents the 30 ft drop impact analysis for the fuel rods and not the reevaluation of the impact time history. As a matter of fact, the time history, Figure 5-1, page V2-47, presented in this document is identical to the time history developed by Stearns-Roger as presented in Appendix V-1 of the GE Safety Analysis Report.

Additionally, as stated in response to previous questions the maximum deceleration forces which the DSC is analyzed for are the 48g vertical and 34g horizontal. These values are to be considered as the governing limits and not the drop height of the cask.

QUESTION: 97

8.2.5.2 Accident Analysis

3. NUTECH has not provided a discussion on the possibility of the cask dropping vertically through 5 feet and then tipping over and slapping down. Logically, if the cask could experience a 5 foot vertical drop, then it would almost certainly also experience a tip-over and slap down. In fact, the slap-down case would be more severe than the 5 foot vertical drop because the centers of gravity of the shipping cask and the DSC both exceed 5 feet in the vertical orientation. Please discuss the reason for not including the slap-down case.

RESPONSE:

As explained in response to question 2 of Section 3.1.2.2, the limiting drop deceleration for the DSC is 34g in the horizontal orientation and 48g in the vertical orientation. The users of NUHOMS Systems need to ensure the DSC is not subject to a drop which could cause deceleration values in excess of these values during handling operations.

Nevertheless as shown in Figure 1 (Page 8.45) the effective height of the drop during a slap down is the difference in the cask center of gravity while standing on its corner and in the horizontal position which is less than 5 feet, and as such the deceleration associated by the slap down is enveloped by the deceleration of the 5 ft horizontal drop.

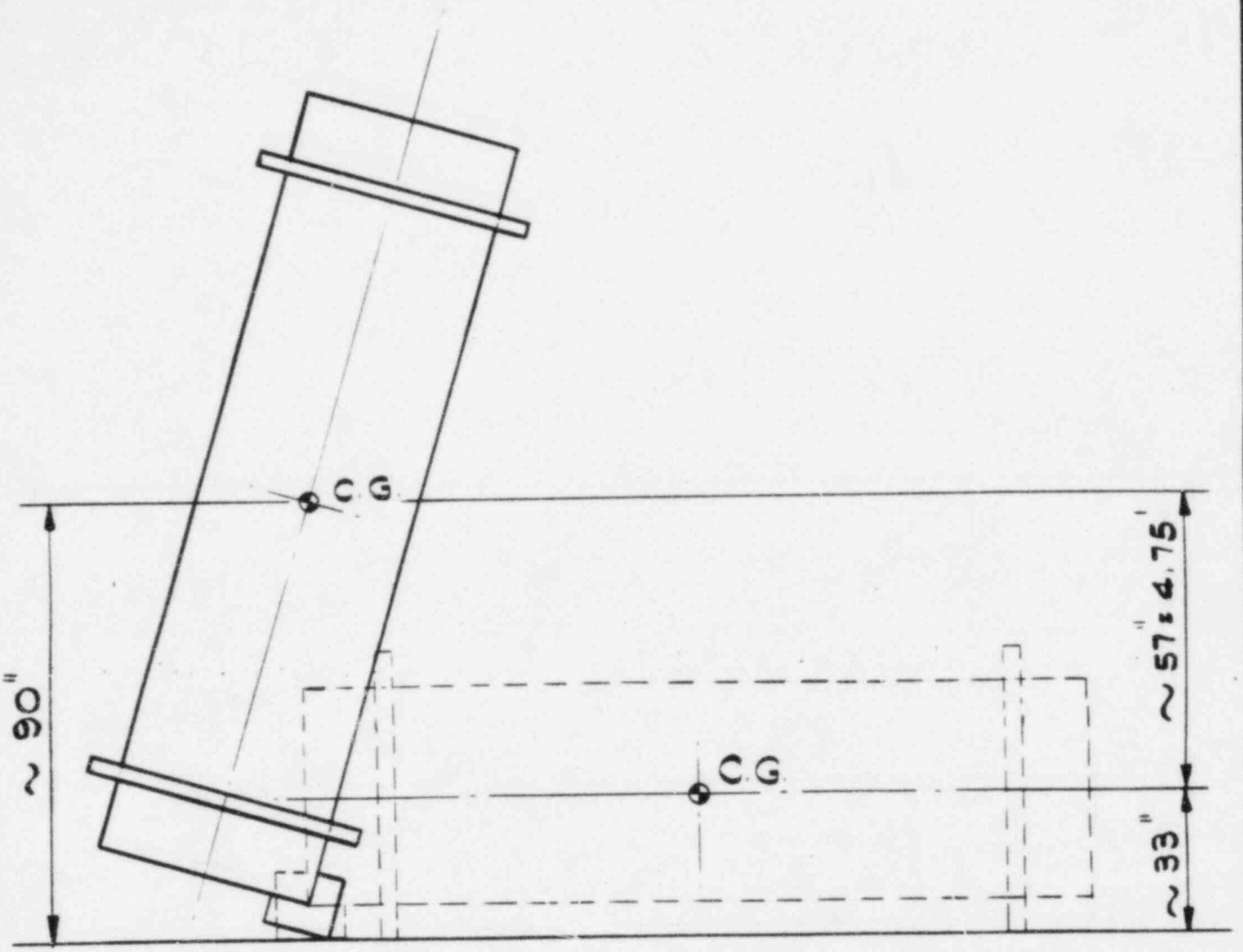

FIGURE 1

QUESTION: 98

8.2.5.2 Accident Analysis

4. In order for the statement of page 8.2-31, "The liner eliminates any secondary impact forces generated by the impact of the two surfaces" to be evaluated, NUTECH should specify what the liner material is and what the dimensions of the liner are. Without these data it is not possible to evaluate what the attenuation or amplification characteristics of the liner might be.

RESPONSE:

The liner material is stainless steel 304. The dimensions of the liner will be dependent on the cask dimensions and fabrication tolerances of the DSC.

QUESTIONS: 99

8.2.5.2 Accident Analysis

5. It appears that the effect of the 2 inch diameter rods was not considered for the horizontal drop case. NUTECH should discuss this omission, or recalculate the stresses in the spacer disc.

RESPONSE:

The weight of the rods in comparison to the weight of the seven fuel assemblies and spacer disk are negligible. Their additional weight would only have a minimal impact on the stresses in the spacer disk. The total weight of the four 26 inch segments of the support rods is 96 pounds while the total weight of the 26 inch segment of the 7 fuel assemblies and spacer disk is 1818.1 pounds. Additionally, the rod locations are in an area away from the fuel assemblies, areas considered to be critical stress locations. Because of their small incremental weight and location, the 2 inch diameter rods were not included in the stress analysis of the spacer disk.

QUESTION: 100

8.2.8 Dry Storage Canister Leakage

The statement that the DSC is designed for no leakage under any conditions cannot be substantiated since very small leakage rates cannot be detected or measured. Helium is difficult to contain, so it would be expected that some decrease in Helium concentration would occur over the lifetime of the canister. Please provide an estimate based on experimental data or analysis of the leakage rate or concentration versus time.

RESPONSE:

Please see the response to question 1, Section 1.1.

QUESTION: 101

8.2.9.1 Accident Analysis

1. What is the basis for using a value of 25% fission gas release fraction as opposed to the 30% upper bound cited from reference 8.42 (should read 8.43) and also quoted on page 8.2-54 in Section 8.2.8?

RESPONSE:

As stated in response to question 1, Section 8.1.1.1, an EPRI study of 124 fuel rods with a large range of linear heat ratings, burnups, enrichment, fuel pellet densities, and operating histories has shown only 0.33% to 12% of the fission gas is released. Furthermore, the EPRI document is much more conclusive than reference 8.43. Also, the 30% upper bound cited on page 8.2-54 is used for radiological assessment and not for pressure calculations. Therefore, the 25% fission gas release exceeds the maximum documented fission gas release of 12%.

Additionally, the 30% release fraction of reference 8.43 is not an "upper bound" of actual release fractions but is the authors' selected conservative value for radiological assessment.

QUESTION: 103

8.2.9.1 Accident Analysis

3. As previously mentioned in comment 4 for Section 8.1.1.1, the effect of diurnal temperature variation on DSC fatigue should be considered in addition to the 50 seasonal cycles.

RESPONSE:

DSC fatigue analysis due to diurnal temperature variation was included in the response to question 2 of Section 1.2.2.

QUESTION: 104

8.2.9.1 Accident Analysis

4. What is the maximum gas inventory within one fuel assembly including fill and fission gases? How was this maximum inventory established? Do criteria need to be established on maximum gas inventory of fuel to be stored? Please discuss.

RESPONSE:

The fill gas for one fuel assembly was assumed to be 9669.6 in^3 at 72°F and 1 atm while the maximum fission gas contained in one fuel assembly was 25071 in^3 at 72°F and 1 atm. The volume of fill gas is based on a free volume of a fuel assembly being filled with helium at 500 psi and 72°F. The fission gas inventory is based on a fuel assembly burnup of 35,000 MWD/MTM and a fission gas production rate of 1 atom per 4 fission.

Because of the high fill gas pressure, 500 psi, that was assumed no criteria needs to be established on the maximum gas inventory of the fuel to be stored.

QUESTION: 105

8.2.10 Load Combinations

1. The load combinations presented in Table 8.2-10 (Page 8.2-61) do not consider the effects of either wind, tornado or flood on the HSM. Shouldn't these loads be considered as required by ACI 349-80. Section 9.2.1? Also shouldn't the material properties be evaluated at the worst thermal case examined, i.e., ambient T=125°F with inlets plugged? (See page 8.1-70).

RESPONSE:

As stated on page 8.2-60 of the Topical Report many of the general event combinations, as shown in Table 3.2-5 are enveloped by the load combinations shown in Table 8.2-10. Hence the effects of wind, tornado and flood were considered, but were enveloped by the cases listed in Table 8.2-10. Results of these accident analyses presented in Chapter 8 verify this statement.

The material properties for the concrete are taken at the temperature of the individual load combination. For example, material properties for load combinations 2, 4, and 10 are taken at the thermal operating temperature since these combinations are for operating conditions. Load case 7, however, contains thermal accident loads. Therefore, material properties for this combination are taken at the HSM temperature when air inlets are blocked and ambient temperature is 125°F.

QUESTION: 106

8.2.10 Load Combinations

2. Please provide an analysis of the HSM corbels, bearing plates, bolts and reinforcing steel for the load combination cases #7 and 10. The temperature of the corbels should be specified and the material properties for temperature should be used.

RESPONSE:

As stated in page 8.1-32 of the Topical Report, slotted holes are used in the wideflange support beams for the purpose of allowing thermal movement, and as such there is no direct thermal force transferred to the corbels. Furthermore as stated in the response to question 3 of Section 8.1.1.5 a multiplier of 1.7 was used for various load combinations presented in Table 8.2-12. The use of 1.7 multiplier conservatively envelopes all the load combination cases specified by ACI 349-80.

Table 8.2-12 will be revised to incorporate the capacity of the corbel, bearing pads and the bolts at both the operating and accident temperatures.

QUESTION: 107

8.2.10 Load Combinations

3. Note 7 in Table 8.2-10 on page 8.2-61 implies that the material properties for the thermal accident load are taken at 300°F, however Table 8.1-2 shows that the maximum concrete temperature for the inside roof is 321°F, and the side wall is 344°F. Please clarify.

RESPONSE:

Note 7 in Table 8.2-10 on page 8.2-61 will be changed to 350°F to conservatively envelope all accident temperatures throughout the HSM.

QUESTION: 108

8.2.10 Load Combinations

4. Table 8.2-11 reports DSC support assembly stresses for various load combinations. The note (3) indicates allowable stresses for the SA 36 structural steel at 200°F. NUTECH should show what the temperature of the DSC is where it and the Tee support assembly rails are in contact for the worst thermal case examined, i.e., ambient T=125°F with inlets plugged (see page 8.1-70).

RESPONSE:

As stated on page 3.2-12, only one accident is considered to occur at one time. Therefore, the HSM and DSC are considered to be at temperatures associated with the normal operating conditions, 70°F ambient temperature during a seismic event or when friction loads are applied. The jammed DSC event is considered to be only credible during the HSM loading operation when the HSM is at ambient temperature 70°F. The allowable stresses for note 3 will be changed to 250°F. This bounds the conservative assumption that the temperature of the DSC support assembly is equal to the exterior surface temperature of the DSC, 230°F.

QUESTION: 109

10.0 OPERATING CONTROLS AND LIMITS

10.1 Proposed Operating Controls and Limits

The fuel stored should also have an axial power peaking of equal or less than 1.08 for decay heat, since this parameter was used in the thermal design.

RESPONSE:

As stated in response to question 2, Section 8.1.3.1, the axial peaking power factor was intended to be a conservatism in the thermal analysis not a limiting parameter on the fuel that may be stored in NUHOMS. The only thermal parameter for fuel is the heat output per fuel assembly, which must be limited to 1.0 kw, as indicated in Section 10.3.1.1.

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QUESTION: 110

10.2.2.2 Technical Conditions and Characteristics

1. Condition 3 regarding the DSC helium leak rate of the primary weld should apply to all welds on the canister including the axial seam weld. Leak rate as a function of temperature also needs to be addressed.

RESPONSE:

Please see the answer to question 1, Section 1.1.

QUESTION: 111

10.2.2.2 Technical Conditions and Characteristics

2. Why is the limiting heat load of 1 kw/assembly not included in the list of seven technical conditions and characteristics?

RESPONSE:

The heat load of 1 kw per assembly is considered to be a functional limit as discussed in Sections 10.2.1 and 10.3.1.

QUESTION: 112

10.2.3 Surveillance Requirements

1. What provisions have been made for inspection of internal air passages for blockage due to buildup of organic matter, insect activity, etc.?

RESPONSE:

Visual inspection of the air inlet passages will be conducted from outside of the HSM. As stated in response to question 1.2.2.1, the internal air passages are not conducive to the growth of organic matter due to radiation and temperature levels.

See response to question 1, Section 1.2.2 for additional information.

QUESTIONS: 113

10.2.3 Surveillance Requirements

2. What provisions have been made for drainage of any water which enters the HSM through the inlets or outlets? Buildup of water could also cause partial or complete blockage of inlet flow in the absence of drains. What inspections are performed to assure that water does not accumulate in the bottom of the HSM?

RESPONSE:

Two 1 inch diameter pipes will be installed in the front wall of the HSM. In the event that any water should enter through the air inlet the pipes will allow for water to drain from the air inlet chamber. This will eliminate the possibility of water building up and causing a partial or complete blockage of the inlet flow. Hence, there is no need to inspect the passage ways to assure that water does not accumulate in the bottom of the HSM.

The air outlets are designed to be water tight and therefore water will not enter into the HSM through this passage.

QUESTION: 114

10.2.3 Surveillance Requirements

3. Surveillance is performed every 48 hours to assure that air is flowing through the module. How will acceptability of the flow rate be determined? How will the flow rate be measured, or how will it be determined that the flow criteria are satisfied.

RESPONSE:

Routine surveillance or inspection of the air inlets conducted on a weekly basis and within 48 hours after an accident events to ensure that no debris is blocking the air inlets or outlets.

The flow rate is caused by the pressure difference between the cold air entering the HSM and the warmer air exiting the HSM. This pressure difference is driven by the decay heat from the DSC. The analysis has shown that the decay heat from the DSC will cause a great enough pressure difference to provide adequate air flow through the HSM. Therefore, there is no need to measure the flow rate through the HSM.

QUESTION: 115

10.3.1.1 Fuel Specifications

Please clarify which parameters are for an assembly and which are for the canister, e.g., neutron source, weight.

RESPONSE:

The following list clarifies which parameters are for the assembly and which are for the canister. This table will be incorporated into the revised Topical Report.

Burnup	$\leq$ 33,000 MWd/Mt
Post irradiation time	$\geq$ 5 years
Initial enrichment	$\leq$ 3.5 % ^{235}U
Weight per distance between any adjacent spacers per assembly	$\leq$ 106.56 kg
Decay power per assembly	$\leq$ 1 kw
Neutron source per canister	9.98×10^{8} n/sec
Gamma source for canister	7.76×19^{15} photons/sec

QUESTION: 116

10.3.2.1 DSC Vacuum Pressure During Drying

What is the basis for the one hour time at pressure criteria for the drying operation? Has the possibility of a waterlogged rod been considered?

RESPONSE:

Based on engineering judgement one hour time at the specified pressure should be sufficient.

A waterlogged fuel assembly has not been considered. Prior to inserting the fuel assemblies into the DSC, a fuel assembly will be visually examined for structural and mechanical integrity.

Additionally, at the temperature and vacuum pressure which the fuel rods will be exposed to during the drying operations, any water in the fuel rods should evaporate and be suctioned from the DSC cavity. If any water does not come out under the vacuum conditions it is not likely to come out with 1 atm of He in the canister.

QUESTION: 117

10.3.2.2 DSC Helium Backfill Pressure

It appears that a hold time at this pressure will need to be specified to assure that thermal equilibrium has been reached.

RESPONSE:

As discussed in the response to question 1, Section 5.1.1.3, the backfilling procedures have been changed to include monitoring the pressure.

QUESTION: 118

10.3.2.3 DSC Helium Leakage Rate of Primary Weld

1. Calculation of 631 cm^3 of He appears to correspond to 2 atmospheres of pressure rather than 1.5 atmospheres.

RESPONSE:

631 cm^3 of He does correspond to 2 atmospheres and 473 cm^3 corresponds to 1.5 atmosphere. 631 cm^3 will be revised to 473 cm^3. This change has no impact on the leak rate specification of the primary weld.

QUESTION: 119

10.3.2.3 DSC Helium Leakage Rate of Primary Weld

2. The leak rate corresponds to the detection level of the helium sniffer. However, the calculation assumes a single leak at this level. In reality, leakage may occur at several locations along the many feet of weld and by diffusion through the metal matrix of the canister itself. Has this type of leakage been considered? Please address.

RESPONSE:

Please see the answer to question 1, Section 1.1.

QUESTION: 120

10.3.2.7 Maximum Air Exit Temperature

1. If the temperature rise is greater than 100°F and small fans are provided as stated in item 5, the passive nature of the cooling mechanism will be lost. Since the design is based on achieving passive cooling, the addition of fans should either be included in the design or eliminated as a corrective action.

RESPONSE:

The addition of fans will be eliminated as a corrective action in the report. If the temperature rise is greater than 100°F, the DSC will be removed from the HSM or additional information and analysis will be provided to show that the existing condition does not represent an unsafe situation.

QUESTION: 121

10.3.2.7 Maximum Air Exit Temperature

2. The cooling air temperature rise is to be checked twenty-four hours after placement of the canister in the HSM. What features of the design preclude the need for later measurements to assure that the 100°F temperature rise criterion is satisfied. If such assurance cannot be provided, then more frequent measurements may be necessary.

RESPONSE:

There are no moving components that could significantly alter the air flow or cause an increase in the temperature change.

QUESTION: 122

10.3.3.1 Surveillance of the HSM Air Inlets

1. How does this surveillance assure that there is no blockage of the outlets or internal blockage? Does surveillance include any measurement of flow or temperature rise of the cooling air?

RESPONSE:

There is no reason to inspect any other HSM air pathways other than the air inlets. Bird screen on the air inlets and outlets will prevent any debris which may significantly alter the air flow through the HSM. There are no lose or moving parts within the HSM that could fail and block the air flow. Additionally, the non-visible portions of the air pathways are not conducive to the growth of organic matter. Therefore, inspection of the air inlets and outlets, the only points where air flow could be restricted, will assure that there is no blockage of the outlets or intervals.

Surveillance does not include measurement of air flow or temperature rise of the cooling air.

QUESTION: 123

10.3.3.1 Surveillance of the HSM Air Inlets

2. Page 10.3-17 states that for "normal operations, inspection of air inlets once per week will assure that any local obstructions can be removed". If the HSMs are inspected once per week, how can NUTECH assume that an air blockage would be no longer than 48 hours? This question also relates to Section 8.2.7.2.

RESPONSE:

Analysis in Chapter 8 showed that no temperature limits are exceeded if all inlets of the HSM are completely blocked. The complete blockage of all inlets and outlets is not expected to occur except during an accident condition. As stated in Section 10.3.3.1, the air inlets will be inspected within 24 hours of an abnormal event.

QUESTION: 124

DETAILS OF HEAT TRANSFER ANALYSIS OF THE NUHOMS SYSTEM

1. On page B.4, it is assumed that the gas behaves the same as the gas in a horizontal annulus. However, on page B.5, a formula said to be applicable for a vertical annulus is used to determine apparent thermal conductivity. Please explain this discrepancy. The gas "annulus" is horizontal for drying and vertical for storage.

RESPONSE:

Reference to the vertical annulus on page B.5 is incorrect. The words vertical on page B.5 and B.6 will be changed to horizontal. The equation listed in Appendix B is used to determine the thermal conductivity of gas in a horizontal annulus.

When the cask is in the vertical position, the most sever temperature conditions will be encountered during vacuum dry of the DSC. As stated on page B.6, the apparent thermal conductivity of the gas in the thermal model was approximated by dividing the apparent thermal conductivity of air in a horizontal position by 1/760.

QUESTION: 125

DETAILS OF HEAT TRANSFER ANALYSIS OF THE NUHOMS SYSTEM

2. The length of the fuel assembly L is given on page B.5, but does not appear to be used in any of the equations. Is this correct? Why is the number cites?

RESPONSE:

Length of the fuel assembly, L, is not required and will be removed in the revised Topical Report.

QUESTION: 126

DETAILS OF HEAT TRANSFER ANALYSIS OF THE NUHOMS SYSTEM

3. Table 8.1-13 gives the average helium temperature for air inlet temperatures of -40, 70 and 125°F as 315, 389 and 429°F. Table B-2 gives apparent helium conductivity at three values of delta T for average gas temperatures of 80, 160, 440 and 620°F. A value of 1.6 was determined for apparent thermal conductivity by averaging the values in Table B-2. In light of the range of helium temperatures for which analyses were performed, it does not seem appropriate to include the values at 620°F, and particularly at 80°F in arriving at the average value. Justify that 1.6 is a representative value for apparent thermal conductivity.

RESPONSE:

The average value of the apparent helium conductivity for the two temperatures values of 160 and 440°F is 1.55. This 0.05 difference in average value will have an insignificant difference in the temperature.

QUESTION: 127

DETAILS OF HEAT TRANSFER ANALYSIS OF THE NUHOMS SYSTEM

4. For the calculation of h_{eff} on page B.13, the assumption of delta-T = 300°F is stated, but does not appear to be needed.

RESPONSE:

The assumption of delta-T = 300°F is necessary. This assumption is used later in the derivation on page B.15.

QUESTION: 128

DETAILS OF HEAT TRANSFER ANALYSIS OF THE NUHOMS SYSTEM

5. Contrary to the statement on page B.16, the two-step approach to using the Wooten-Epstein Formula (WEF) appears to be closer to the actual application. The second step is essentially the manner in which the result is used.

RESPONSE:

The first step is deriving the boral sleeve temperature considering the DSC wall temperature and a pseudo assembly of 7 rods. The second step goes from the boral guide sleeve temperature to the central rod temperature using a single assembly.

QUESTION: 129

DETAILS OF HEAT TRANSFER ANALYSIS OF THE NUHOMS SYSTEM

6. Corrected values for K_{fuel} for the alternative WEF approach should be provided.

RESPONSE:

The correct value for K_{fuel} using the WEF on a single 15x15 fuel assembly at the range of expected temperatures is 5.23 k_{He}.

QUESTION: 130

SAMPLE COMPUTER INPUT AND OUTPUT FOR THE NUHOMS STRUCTURAL ANALYSIS

STARDYNE Finite Element Analysis Data. Results have been presented in the Topical Report that are based upon STARDYNE Finite Element Analyses. An example of the input and output data from one of these analyses is presented in Appendix C. Portions of the input and output data from some of the other analyses were submitted in response to an earlier question. However, the data submitted to date is not sufficient to permit the checking of stress analysis data for all points on the NUHOMS system that exhibit maximum stresses for the various loading conditions discussed in Section 8. In addition to the STARDYNE results, it is understood that some of the stress analysis data of interest is presented through the use of computerized post-processor tabulations. Therefore, it is requested that a sufficient quantity of STARDYNE and post-processor computer output data be submitted so as to trace the source of the maximum stress in each NUHOMS component evaluated using such analyses. It is not necessary to resubmit previously submitted data nor to submit complete sets of computer output for each analysis. Specific Tables for which the above information is requested are: Table 8.1-7, 8.1-8, 8.2-7 and 8.2-11.

RESPONSE:

Attachments 11, 12, and 13 will be provided to supplement the computer data already presented. The listing below shows the appropriate computer output attachment in which the corresponding stress values for Tables 8.1-7, 8.1-8, 8.2-7, 8.2-9 and 8.2-11 are derived. Those components not listed were analyzed by hand calculations and therefore were not included.

Table	Component	Loading	Attachment
8.1-7	Spacer Disk	Dead Weight	13
8.1-8	W8x28	All Loads	7(1)
8.1-8	WT4x33.5	All Loads	7(1)
8.2-7	Canister Shell	5-Foot Drop	11

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Table	Component	Loading	Attachment
8.2-7	Bottom Inner Pressure Plate	5-Foot Drop	11
8.2-7	Top Lead Plug	5-Foot Drop	9(1)
8.2-7	Support RIng	5-Foot Drop	9(1)
8.2-7	Spacer Disk	5-Foot Drop	12
8.2-7	Boral Tubes	5-Foot Drop	10(1)
8.2-9	DSC Shell, Bottom Inner Pressure Plate, Top Lead Plug, Support Ring, Spacer Disk & Boral Tube	Load Combinations	Tables 8.1-7 & 8.2-7
8.2-11	W8x28	Load Combinations	7
8.2-11	WT4x33.5	Load Combinations	7

Note
1. Attachments 7, 9 and 10 were previously submitted to NRC.

ATTACHMENT 11

STARDYNE Inputs and Outputs
for the Bottom Inner Pressure
Plate and Canister Shell
5 Foot Drop Analyses

FILE NO. ADYDAI-0501
REVISION 0 PAGE 3-52
PREPARED BY BWE/10-5-84
CHECKED BY NGC 10/26/84

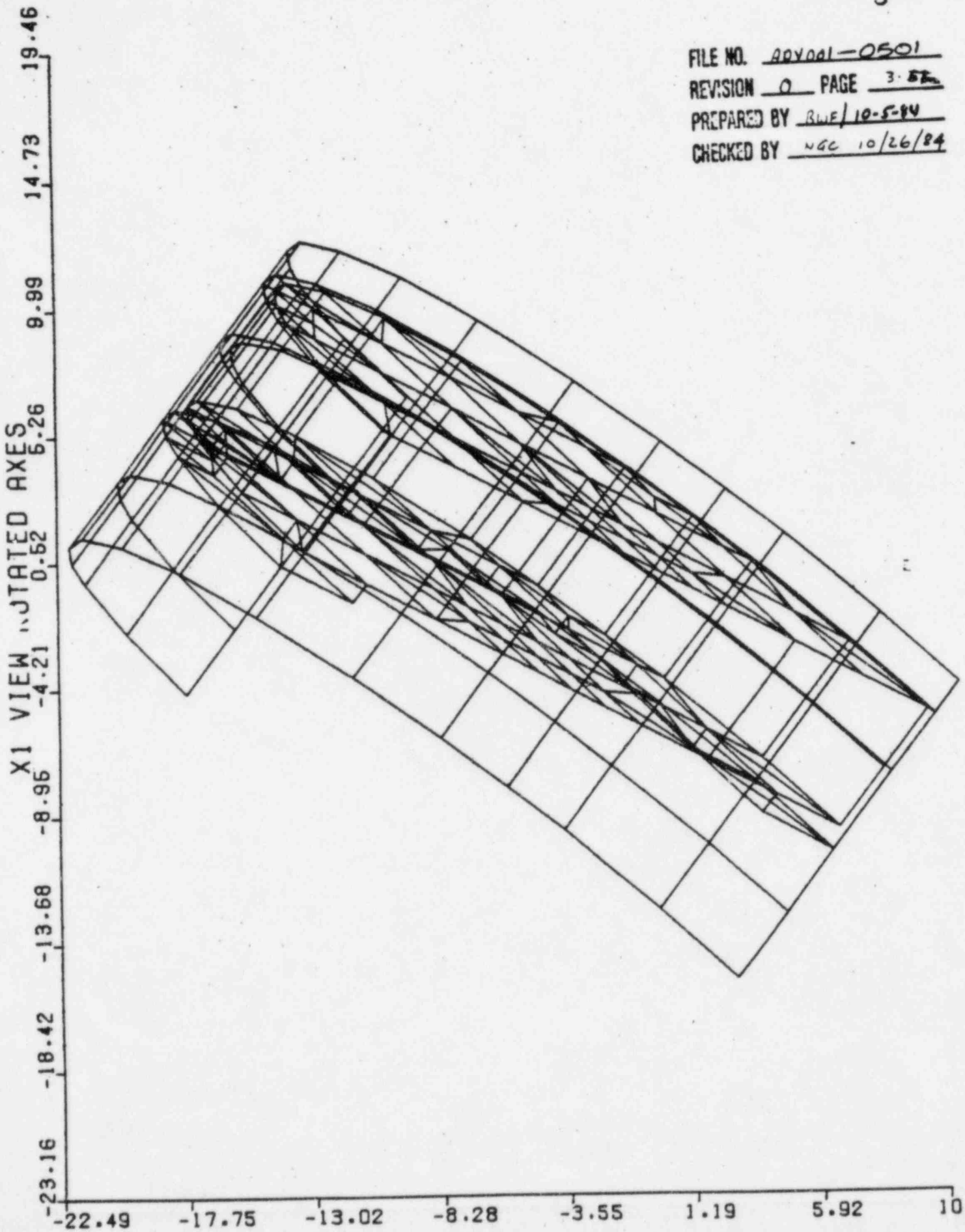
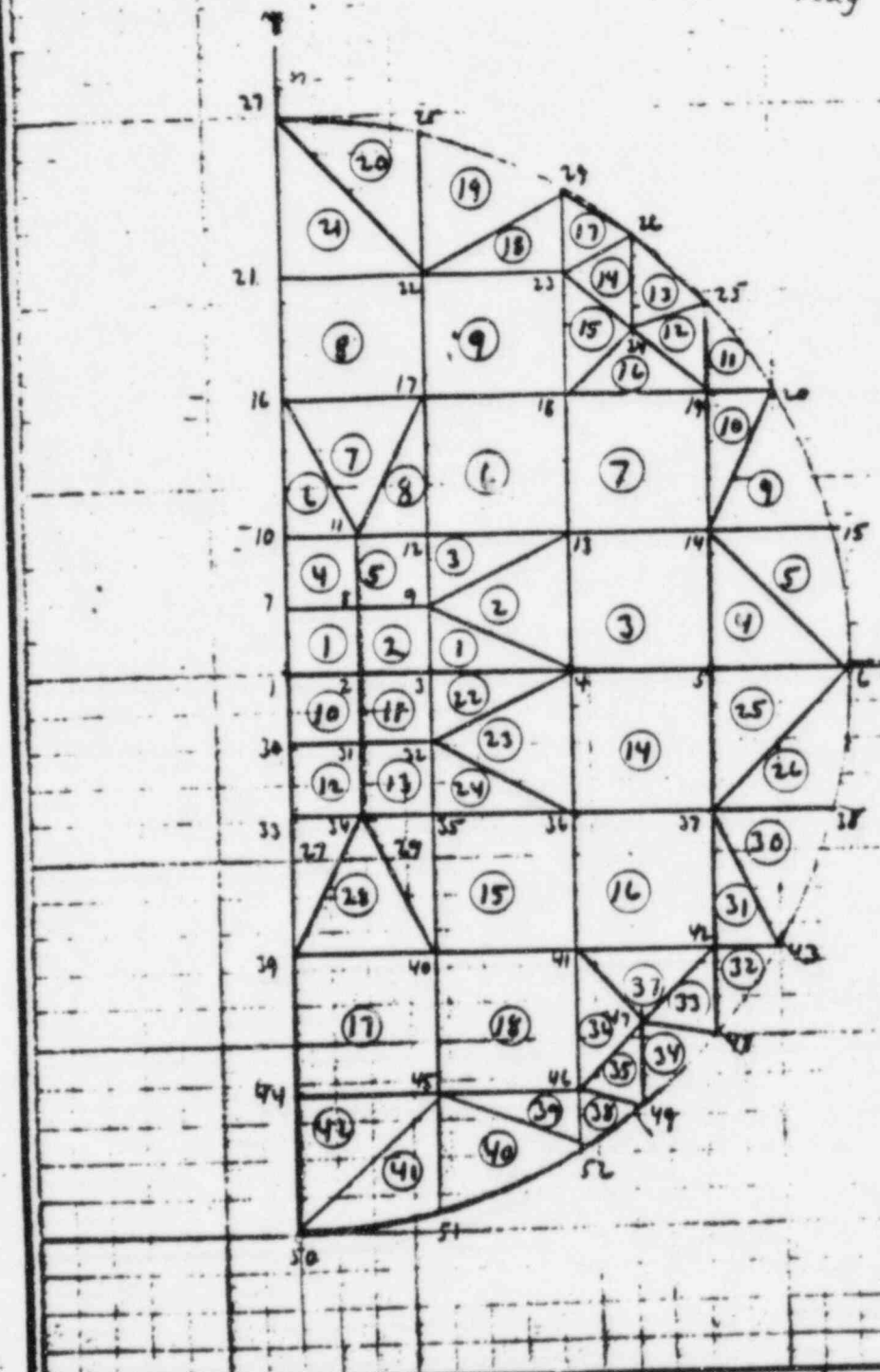


Figure 3.8
Lead Plug Model

Fig. 3-9 - Model for Top Plate of Lead Plug



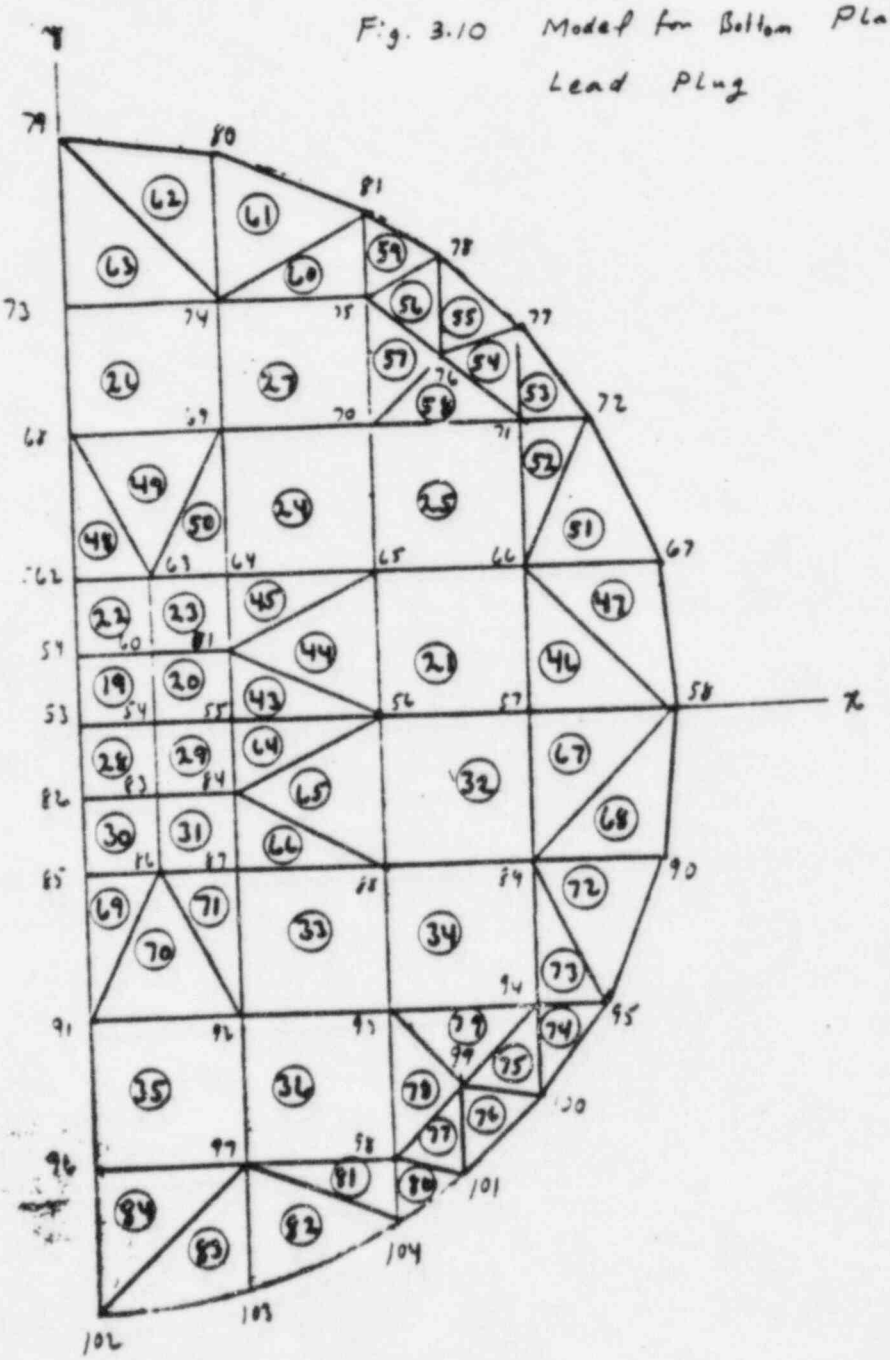
Revision	0					
Prepared By/Date	DWF/10-5-84					
Accuracy Chk By/Date	NGV. 10/26/84					
Criteria Chk By/Date	N/A					

PROJECT NUHOMS GENERIC DESIGN FILE NO. ADV 001-0501

OWNER NUTECH INC.

CLIENT NUTECH INC

Fig. 3.10 Model for Bottom Plate of Lead Plug



Revision	0					PAGE 3.63
Prepared By/Date	BWF/10-5-84					OF 3.96
Accuracy Chk By/Date	NGC 10/26/84					
Criteria Chk By/Date	N/A					

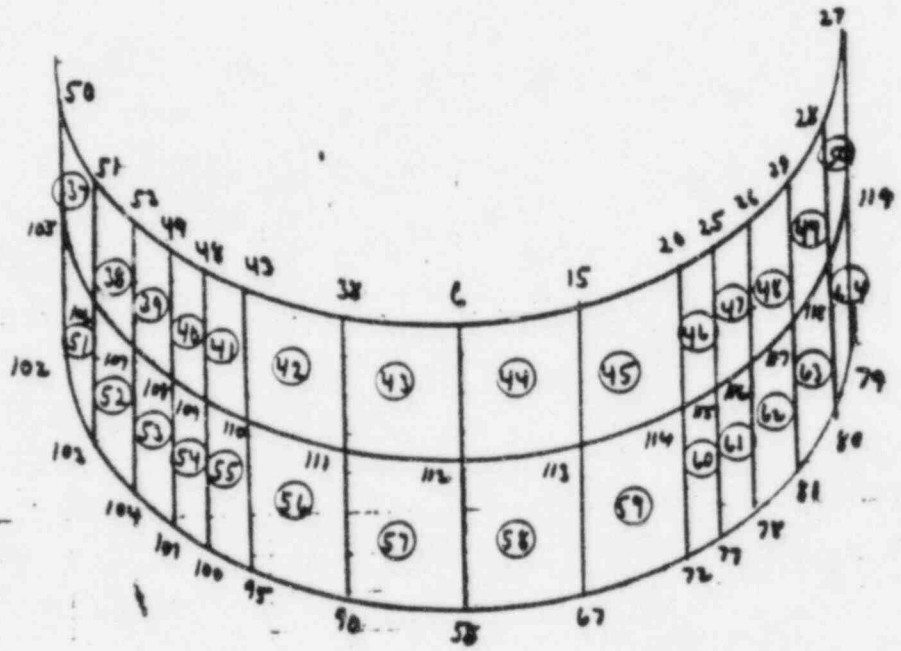


Figure 3.11

Model for Cylindrical Shell of Lead Plug

Revision	0					PAGE 3.64
Prepared By/Date	BWF/10-5-94					
Accuracy Chk By/Date	MJC 10/26/94					OF 3.96
Criteria Chk By/Date	N/A					

Project: NUHOMS GENERIL DESIGN
Owner : NUTECH INC
Client : NUTECH INC

FILE NO. ADV 001-0501
REVISION 0 PAGE 3.65
PREPARED BY AWF/10-5-84
CHECKED BY NGC 10/26/84

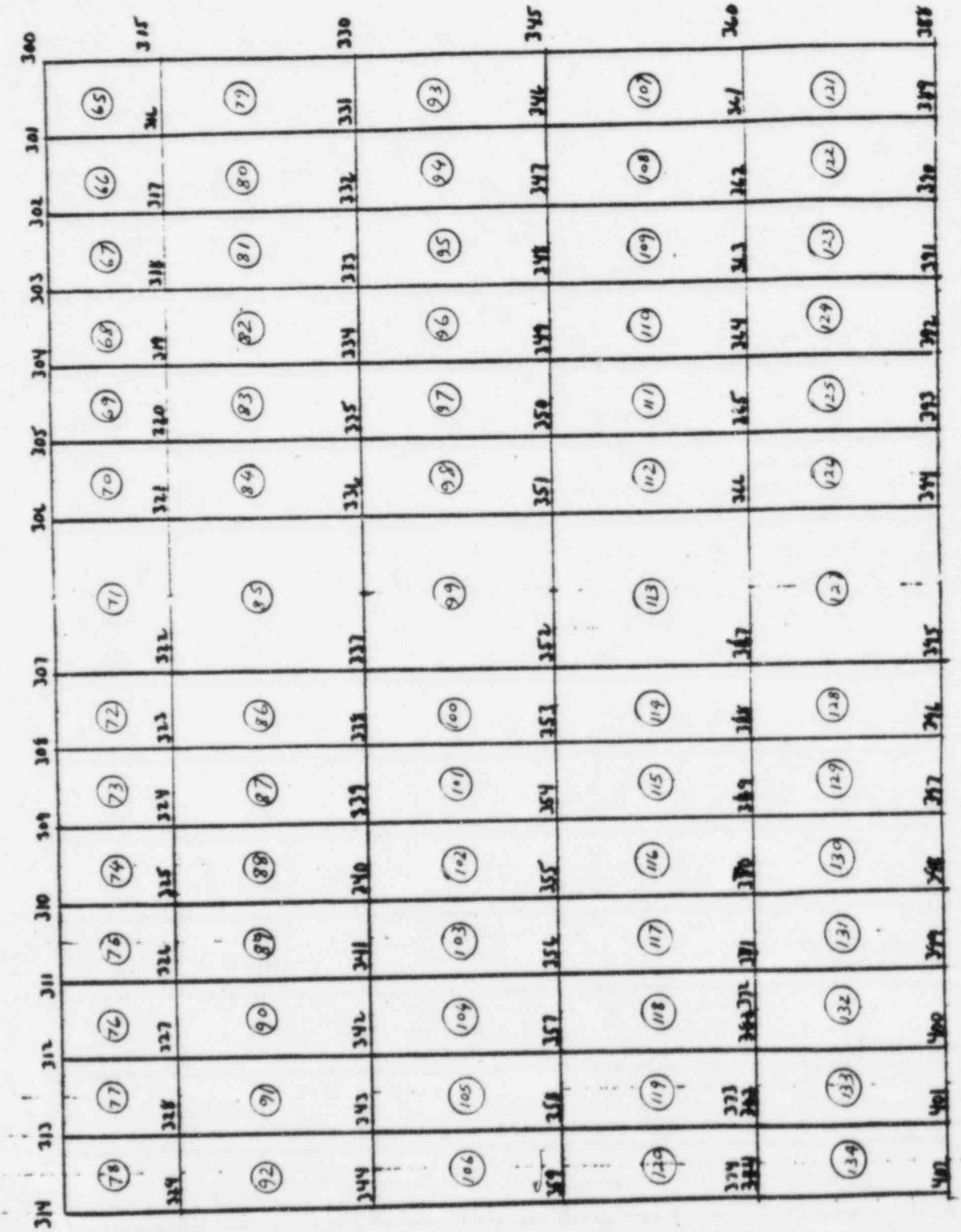


Figure 3.12
Canister Nodes & Elements
in Lead Plug Model

Project: NUHOMS GENERIC DESIGN

OWNER: NUTECH INC

Client: NUTECH INC

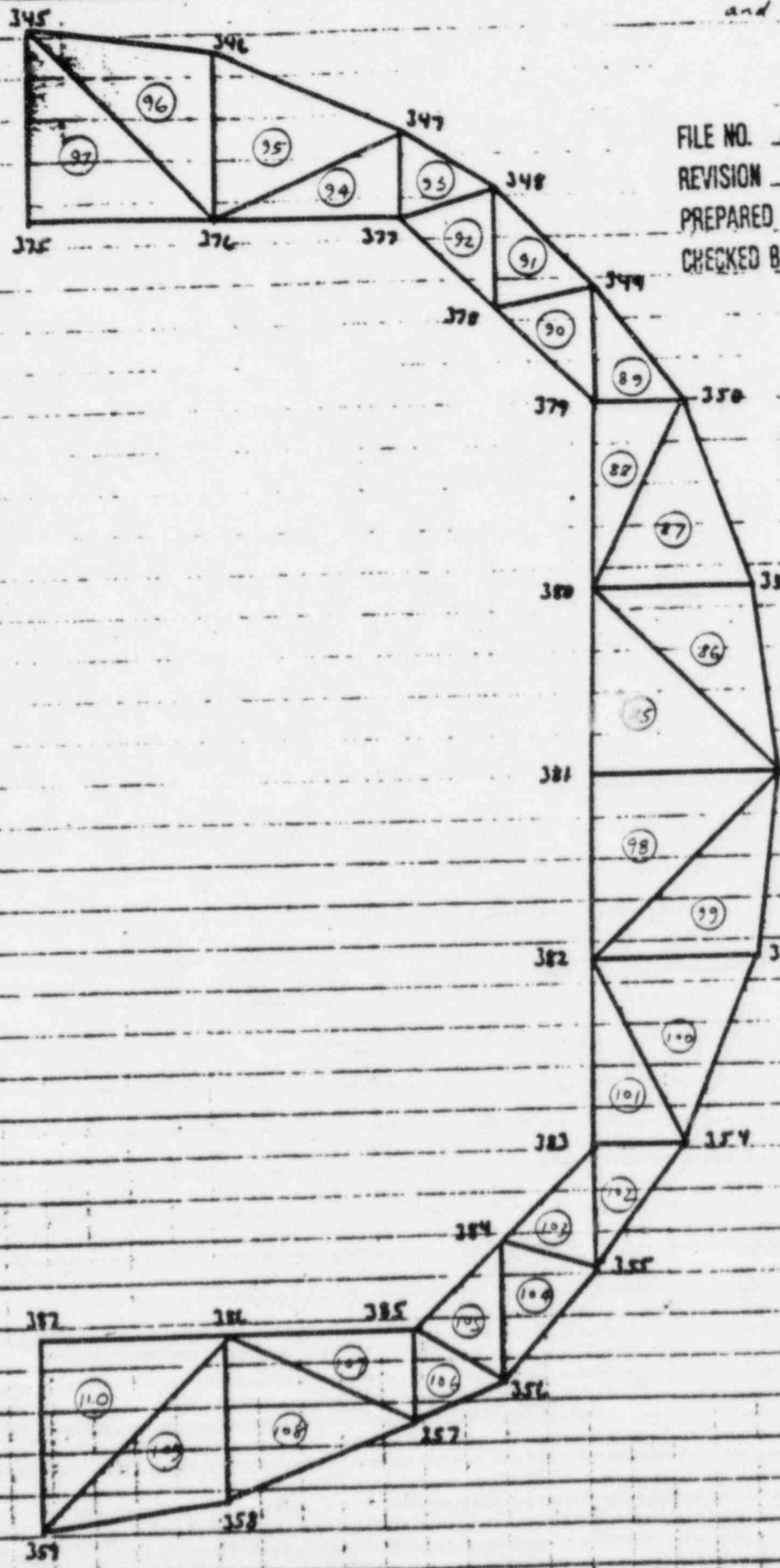
Figure 3.13 Support Ring Nodes and Element in Lead Model

FILE NO. ADV001-0501

REVISION 0 PAGE 3.66

PREPARED BY RWE/10-5-84

CHECKED BY NGC 10/26/84



(d) Bottom Cover Plate

- A finite element model similar to that used for the top leaded plug was developed to analyze the 5-ft vertical drop.
- The node numbers and element numbers for the model are essentially the same as that for the top leaded plug model with the following exceptions:
  - (a) The ring elements were deleted
  - (b) The top row elements of the canister shell (Element Nos 65 to 78 of Figure 3.5) were deleted
  - (c) A thickness of 1.5" was used for both the top and bottom plates. Both plates were connected to the canister shell by beams with relatively large stiffnesses
  - (d) The model was rotated such that the top plate for the top leaded plug model became the bottom plate for this model.
  - (e) The nodal points of this model were restrained axially in the vertical direction.
  - (f) Weights acting on this model were lumped on the top plate. Total weight is calculated as follows.

- Wt of top plate = $\pi/8^2 \times 1.5 \times 0.283$ = 432 lbs
- Wt of Spent Fuel = 10154 lbs
- Wt of 4 x 2" ϕ steel Rods = 568 lbs
- Wt of 7 spacer disks = 1086 lbs
- Wt of 7 boron tubes = 843 lbs

Total Wt = 13083 lb

∴ Wt per unit volume of plate = $\frac{13083}{\pi \times 18^2 \times 1.5}$ = 8.57 lb/in^3

- The model was subjected to an acceleration of 48g in the vertical direction (Refs. 16 and 17)

- Max Membrane SI = 0.64 ksi and max membrane + bending SI = 39.77 ksi (inner bottom pressure plate)

Note
A max membrane SI of 14.97 ksi was obtained for the cylindrical shell of the Lead Plug casing. However this is bounded by the membrane SI obtained for the canister casing (15.52 ksi from page 3.59)

CARD IMAGE

```
        1   4    8   12   16   20   24   28   32   36   40   44   48   52   56   60   64   68   72   76   80
        *   *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *
CARD NO ********************************************************************************************** CARD TYPE
      2 MATLG       1      SS304     28.6E6          0.30      0.2834                                     MATLG
      3 MATLG       2     LSS304     28.6E6          0.30      8.5700                                     MATLG
      4 END                                                                                               END
      5 NODE    1            0.0000              0.0000            0.0000                                 NODE
      6 NODE    2            2.2500              0.0000            0.0000                                 NODE
      7 NODE    3            4.5000              0.0000            0.0000                                 NODE
      8 NODE    4            9.0000              0.0000            0.0000                                 NODE
      9 NODE    5           13.5000              0.0000            0.0000                                 NODE
     10 NODE    6           17.7500              0.0000            0.0000                                 NODE
     11 NODE    7            0.0000              2.2500            0.0000                                 NODE
     12 NODE    8            2.2500              2.2500            0.0000                                 NODE
     13 NODE    9            4.5000              2.2500            0.0000                                 NODE
     14 NODE   10            0.0000              4.5000            0.0000                                 NODE
     15 NODE   11            2.2500              4.5000            0.0000                                 NODE
     16 NODE   12            4.5000              4.5000            0.0000                                 NODE
     17 NODE   13            9.0000              4.5000            0.0000                                 NODE
     18 NODE   14           13.5000              4.5000            0.0000                                 NODE
     19 NODE   15           17.1700              4.5000            0.0000                                 NODE
     20 NODE   16            0.0000              9.0000            0.0000                                 NODE
     21 NODE   17            4.5000              9.0000            0.0000                                 NODE
     22 NODE   18            9.0000              9.0000            0.0000                                 NODE
     23 NODE   19           13.5000              9.0000            0.0000                                 NODE
     24 NODE   20           15.2990              9.0000            0.0000                                 NODE
     25 NODE   21            0.0000             13.5000            0.0000                                 NODE
     26 NODE   22            4.5000             13.5000            0.0000                                 NODE
     27 NODE   23            9.0000             13.5000            0.0000                                 NODE
     28 NODE   24           11.2500             11.2500            0.0000                                 NODE
     29 NODE   25           13.5000             11.5244            0.0000                                 NODE
     30 NODE   26           11.2500             13.7295            0.0000                                 NODE
     31 NODE   27            0.0000             17.7500            0.0000                                 NODE
     32 NODE   28            4.5000             17.1700            0.0000                                 NODE
     33 NODE   29            9.0000             15.2990            0.0000                                 NODE
     34 NODE   30            0.0000             -2.2500            0.0000                                 NODE
     35 NODE   31            2.2500             -2.2500            0.0000                                 NODE
     36 NODE   32            4.5000             -2.2500            0.0000                                 NODE
     37 NODE   33            0.0000             -4.5000            0.0000                                 NODE
     38 NODE   34            2.2500             -4.5000            0.0000                                 NODE
     39 NODE   35            4.5000             -4.5000            0.0000                                 NODE
     40 NODE   36            9.0000             -4.5000            0.0000                                 NODE
     41 NODE   37           13.5000             -4.5000            0.0000                                 NODE
     42 NODE   38           17.1700             -4.5000            0.0000                                 NODE
     43 NODE   39            0.0000             -9.0000            0.0000                                 NODE
     44 NODE   40            4.5000             -9.0000            0.0000                                 NODE
     45 NODE   41            9.0000             -9.0000            0.0000                                 NODE
     46 NODE   42           13.5000             -9.0000            0.0000                                 NODE
     47 NODE   43           15.2990             -9.0000            0.0000                                 NODE
     48 NODE   44            0.0000            -13.5000            0.0000                                 NODE
     49 NODE   45            4.5000            -13.5000            0.0000                                 NODE
     50 NODE   46            9.0000            -13.5000            0.0000                                 NODE
     51 NODE   47           11.2500            -11.2500            0.0000                                 NODE
     52 NODE   48           13.5000            -11.5244            0.0000                                 NODE
     53 NODE   49           11.2500            -13.7295            0.0000                                 NODE
     54 NODE   50            0.0000            -17.7500            0.0000                                 NODE
```

CARD IMAGE

CARD NO	1 4	8	12 16	20 24	28 32	36 40	44 48	52 56	60 64	68 72	76 80	CARD TYPE
55	NODE	51		4.5000		-17.1700		0.0000				NODE
56	NODE	52		9.0000		-15.2990		0.0000				NODE
57	NODE	53		0.0000		0.0000		-5.5000				NODE
58	NODE	54		2.2500		0.0000		-5.5000				NODE
59	NODE	55		4.5000		0.0000		-5.5000				NODE
60	NODE	56		9.0000		0.0000		-5.5000				NODE
61	NODE	57		13.5000		0.0000		-5.5000				NODE
62	NODE	58		17.7500		0.0000		-5.5000				NODE
63	NODE	59		0.0000		2.2500		-5.5000				NODE
64	NODE	60		2.2500		2.2500		-5.5000				NODE
65	NODE	61		4.5000		2.2500		-5.5000				NODE
66	NODE	62		0.0000		4.5000		-5.5000				NODE
67	NODE	63		2.2500		4.5000		-5.5000				NODE
68	NODE	64		4.5000		4.5000		-5.5000				NODE
69	NODE	65		9.0000		4.5000		-5.5000				NODE
70	NODE	66		13.5000		4.5000		-5.5000				NODE
71	NODE	67		17.1700		4.5000		-5.5000				NODE
72	NODE	68		0.0000		9.0000		-5.5000				NODE
73	NODE	69		4.5000		9.0000		-5.5000				NODE
74	NODE	70		9.0000		9.0000		-5.5000				NODE
75	NODE	71		13.5000		9.0000		-5.5000				NODE
76	NODE	72		15.2990		9.0000		-5.5000				NODE
77	NODE	73		0.0000		13.5000		-5.5000				NODE
78	NODE	74		4.5000		13.5000		-5.5000				NODE
79	NODE	75		9.0000		13.5000		-5.5000				NODE
80	NODE	76		11.2500		11.2500		-5.5000				NODE
81	NODE	77		13.5000		11.5244		-5.5000				NODE
82	NODE	78		11.2500		13.7295		-5.5000				NODE
83	NODE	79		0.0000		17.7500		-5.5000				NODE
84	NODE	80		4.5000		17.1700		-5.5000				NODE
85	NODE	81		9.0000		15.2990		-5.5000				NODE
86	NODE	82		0.0000		-2.2500		-5.5000				NODE
87	NODE	83		2.2500		-2.2500		-5.5000				NODE
88	NODE	84		4.5000		-2.2500		-5.5000				NODE
89	NODE	85		0.0000		-4.5000		-5.5000				NODE
90	NODE	86		2.2500		-4.5000		-5.5000				NODE
91	NODE	87		4.5000		-4.5000		-5.5000				NODE
92	NODE	88		9.0000		-4.5000		-5.5000				NODE
93	NODE	89		13.5000		-4.5000		-5.5000				NODE
94	NODE	90		17.1700		-4.5000		-5.5000				NODE
95	NODE	91		0.0000		-9.0000		-5.5000				NODE
96	NODE	92		4.5000		-9.0000		-5.5000				NODE
97	NODE	93		9.0000		-9.0000		-5.5000				NODE
98	NODE	94		13.5000		-9.0000		-5.5000				NODE
99	NODE	95		15.2990		-9.0000		-5.5000				NODE
100	NODE	96		0.0000		-13.5000		-5.5000				NODE
101	NODE	97		4.5000		-13.5000		-5.5000				NODE
102	NODE	98		9.0000		-13.5000		-5.5000				NODE
103	NODE	99		11.2500		-11.2500		-5.5000				NODE
104	NODE	100		13.5000		-11.5244		-5.5000				NODE
105	NODE	101		11.2500		-13.7295		-5.5000				NODE
106	NODE	102		0.0000		-17.7500		-5.5000				NODE
107	NODE	103		4.5000		-17.1700		-5.5000				NODE
108	NODE	104		9.0000		-15.2990		-5.5000				NODE

CARD IMAGE

1 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80

CARD NO					CARD TYPE
109	NODE	105	0.0000	-17.7500	-2.7500	NODE
110	NODE	106	4.5000	-17.1700	-2.7500	NODE
111	NODE	107	9.0000	-15.2990	-2.7500	NODE
112	NODE	108	11.2500	-13.7295	-2.7500	NODE
113	NODE	109	13.5000	-11.5244	-2.7500	NODE
114	NODE	110	15.2990	-9.0000	-2.7500	NODE
115	NODE	111	17.1700	-4.5000	-2.7500	NODE
116	NODE	112	17.7500	0.0000	-2.7500	NODE
117	NODE	113	17.1700	4.5000	-2.7500	NODE
118	NODE	114	15.2990	9.0000	-2.7500	NODE
119	NODE	115	13.5000	11.5244	-2.7500	NODE
120	NODE	116	11.2500	13.7295	-2.7500	NODE
121	NODE	117	9.0000	15.2990	-2.7500	NODE
122	NODE	118	4.5000	17.1700	-2.7500	NODE
123	NODE	119	0.0000	17.7500	-2.7500	NODE
124	NODE	200	0.0000	0.0000	-1.5000	NODE
125	NODE	201	0.0000	0.0000	-12.3750	NODE
126	NODE	202	0.0000	0.0000	1.5000	NODE
127	NODE	203	0.0000	0.0000	3.0000	NODE
128	NODE	315	0.0000	18.2500	0.0000	NODE
129	NODE	316	4.5000	17.6865	0.0000	NODE
130	NODE	317	9.0000	15.8765	0.0000	NODE
131	NODE	318	11.2500	14.3700	0.0000	NODE
132	NODE	319	13.5000	12.2806	0.0000	NODE
133	NODE	320	15.8765	9.0000	0.0000	NODE
134	NODE	321	17.6865	4.5000	0.0000	NODE
135	NODE	322	18.2500	0.0000	0.0000	NODE
136	NODE	323	17.6865	-4.5000	0.0000	NODE
137	NODE	324	15.8765	-9.0000	0.0000	NODE
138	NODE	325	13.5000	-12.2806	0.0000	NODE
139	NODE	326	11.2500	-14.3700	0.0000	NODE
140	NODE	327	9.0000	-15.8765	0.0000	NODE
141	NODE	328	4.5000	-17.6865	0.0000	NODE
142	NODE	329	0.0000	-18.2500	0.0000	NODE
143	NODE	330	0.0000	18.2500	-2.7500	NODE
144	NODE	331	4.5000	17.6865	-2.7500	NODE
145	NODE	332	9.0000	15.8765	-2.7500	NODE
146	NODE	333	11.2500	14.3700	-2.7500	NODE
147	NODE	334	13.5000	12.2806	-2.7500	NODE
148	NODE	335	15.8765	9.0000	-2.7500	NODE
149	NODE	336	17.6865	4.5000	-2.7500	NODE
150	NODE	337	18.2500	0.0000	-2.7500	NODE
151	NODE	338	17.6865	-4.5000	-2.7500	NODE
152	NODE	339	15.8765	-9.0000	-2.7500	NODE
153	NODE	340	13.5000	-12.2806	-2.7500	NODE
154	NODE	341	11.2500	-14.3700	-2.7500	NODE
155	NODE	342	9.0000	-15.8765	-2.7500	NODE
156	NODE	343	4.5000	-17.6865	-2.7500	NODE
157	NODE	344	0.0000	-18.2500	-2.7500	NODE
158	NODE	345	0.0000	18.2500	-5.5000	NODE
159	NODE	346	4.5000	17.6865	-5.5000	NODE
160	NODE	347	9.0000	15.8765	-5.5000	NODE
161	NODE	348	11.2500	14.3700	-5.5000	NODE
162	NODE	349	13.5000	12.2806	-5.5000	NODE

CARD IMAGE

CARD NO						CARD TYPE
163	NODE	350	15.8765	9.0000	-5.5000	NODE
164	NODE	351	17.6865	4.5000	-5.5000	NODE
165	NODE	352	18.2500	0.0000	-5.5000	NODE
166	NODE	353	17.6865	-4.5000	-5.5000	NODE
167	NODE	354	15.8765	-9.0000	-5.5000	NODE
168	NODE	355	13.5000	-12.2806	-5.5000	NODE
169	NODE	356	11.2500	-14.3700	-5.5000	NODE
170	NODE	357	9.0000	-15.8765	-5.5000	NODE
171	NODE	358	4.5000	-17.6865	-5.5000	NODE
172	NODE	359	0.0000	-18.2500	-5.5000	NODE
173	NODE	360	0.0000	18.2500	-9.3250	NODE
174	NODE	361	4.5000	17.6865	-9.3250	NODE
175	NODE	362	9.0000	15.8765	-9.3250	NODE
176	NODE	363	11.2500	14.3700	-9.3250	NODE
177	NODE	364	13.5000	12.2806	-9.3250	NODE
178	NODE	365	15.8765	9.0000	-9.3250	NODE
179	NODE	366	17.6865	4.5000	-9.3250	NODE
180	NODE	367	18.2500	0.0000	-9.3250	NODE
181	NODE	368	17.6865	-4.5000	-9.3250	NODE
182	NODE	369	15.8765	-9.0000	-9.3250	NODE
183	NODE	370	13.5000	-12.2806	-9.3250	NODE
184	NODE	371	11.2500	-14.3700	-9.3250	NODE
185	NODE	372	9.0000	-15.8765	-9.3250	NODE
186	NODE	373	4.5000	-17.6865	-9.3250	NODE
187	NODE	374	0.0000	-18.2500	-9.3250	NODE
188	NODE	388	0.0000	18.2500	-12.3750	NODE
189	NODE	389	4.5000	17.6865	-12.3750	NODE
190	NODE	390	9.0000	15.8765	-12.3750	NODE
191	NODE	391	11.2500	14.3700	-12.3750	NODE
192	NODE	392	13.5000	12.2806	-12.3750	NODE
193	NODE	393	15.8765	9.0000	-12.3750	NODE
194	NODE	394	17.6865	4.5000	-12.3750	NODE
195	NODE	395	18.2500	0.0000	-12.3750	NODE
196	NODE	396	17.6865	-4.5000	-12.3750	NODE
197	NODE	397	15.8765	-9.0000	-12.3750	NODE
198	NODE	398	13.5000	-12.2806	-12.3750	NODE
199	NODE	399	11.2500	-14.3700	-12.3750	NODE
200	NODE	400	9.0000	-15.8765	-12.3750	NODE
201	NODE	401	4.5000	-17.6865	-12.3750	NODE
202	NODE	402	0.0000	-18.2500	-12.3750	NODE
203	END					END
204	RESTG		389 401	1001000		RESTG
205	RESTG		316 328	1001000		RESTG
206	RESTG		2 6	1001000		RESTG
207	RESTG		8 9	1001000		RESTG
208	RESTG		11 15	1001000		RESTG
209	RESTG		17 20	1001000		RESTG
210	RESTG		22 24	1001000		RESTG
211	RESTG		25 26	1001000		RESTG
212	RESTG		28 29	1001000		RESTG
213	RESTG		31 32	1001000		RESTG
214	RESTG		34 38	1001000		RESTG
215	RESTG		40 43	1001000		RESTG
216	RESTG		45 47	1001000		RESTG

CARD IMAGE

CARD NO	1 4	9 12	16 20	24 28	32 36	40 44	48 52	56 60	64 68	72 76 80	CARD TYPE
217	RESTG	49	49	1001000							RESTG
218	RESTG	51	52	1001000							RESTG
219	RESTG	388		011110							RESTG
220	RESTG	402		011110							RESTG
221	RESTG	330	360	15100011							RESTG
222	RESTG	344	374	15100011							RESTG
223	RESTG	329		101011							RESTG
224	RESTG	402		100011							RESTG
225	RESTG	105		100011							RESTG
226	RESTG	119		100011							RESTG
227	RESTG	1		101011							RESTG
228	RESTG	7		101011							RESTG
229	RESTG	10		101011							RESTG
230	RESTG	16		101011							RESTG
231	RESTG	21		101011							RESTG
232	RESTG	27		101011							RESTG
233	RESTG	50		101011							RESTG
234	RESTG	44		101011							RESTG
235	RESTG	39		101011							RESTG
236	RESTG	33		101011							RESTG
237	RESTG	30		100011							RESTG
238	RESTG	53		100011							RESTG
239	RESTG	59		100011							RESTG
240	RESTG	62		100011							RESTG
241	RESTG	68		100011							RESTG
242	RESTG	73		100011							RESTG
243	RESTG	79		100011							RESTG
244	RESTG	102		100011							RESTG
245	RESTG	98		100011							RESTG
246	RESTG	91		100011							RESTG
247	RESTG	85		100011							RESTG
248	RESTG	82		100011							RESTG
249	END										END
250	BEAMG	1	65	13	12	1	1				BEAMG
251	BEAMG	2	88	36	35	1	1				BEAMG
252	BEAMG	3	91	39	40	1	2				BEAMG
253	BEAMG	4	68	16	17	1	2				BEAMG
254	BEAMG	18	315	27	330	1	3				BEAMG
255	BEAMG	19	316	28	331	1	3				BEAMG
256	BEAMG	20	317	29	332	1	3				BEAMG
257	BEAMG	21	318	26	333	1	3				BEAMG
258	BEAMG	22	319	25	334	1	3				BEAMG
259	BEAMG	23	320	20	335	1	3				BEAMG
260	BEAMG	24	321	15	336	1	3				BEAMG
261	BEAMG	25	322	6	337	1	3				BEAMG
262	BEAMG	26	323	38	338	1	3				BEAMG
263	BEAMG	27	324	43	339	1	3				BEAMG
264	BEAMG	28	325	48	340	1	3				BEAMG
265	BEAMG	29	326	49	341	1	3				BEAMG
266	BEAMG	30	327	52	342	1	3				BEAMG
267	BEAMG	31	328	51	343	1	3				BEAMG
268	BEAMG	32	329	50	344	1	3				BEAMG
269	BEAMG	33	345	79	360	1	3				BEAMG
270	BEAMG	34	346	80	361	1	3				BEAMG

CARD IMAGE

CARD NO	1 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80	CARD TYPE
271	BEAMG 35 347 81 362 1 3	BEAMG
272	BEAMG 36 348 78 363 1 3	BEAMG
273	BEAMG 37 349 77 364 1 3	BEAMG
274	BEAMG 38 350 72 365 1 3	BEAMG
275	BEAMG 39 351 67 366 1 3	BEAMG
276	BEAMG 40 352 58 367 1 3	BEAMG
277	BEAMG 41 353 90 368 1 3	BEAMG
278	BEAMG 42 354 95 369 1 3	BEAMG
279	BEAMG 43 355 100 370 1 3	BEAMG
280	BEAMG 44 356 101 371 1 3	BEAMG
281	BEAMG 45 357 104 372 1 3	BEAMG
282	BEAMG 46 358 103 373 1 3	BEAMG
283	BEAMG 47 359 102 374 1 3	BEAMG
284	END	END
285	BPROP1 1 0.11040 0.0019410 0.0009700 0.0009700 0.89	BPROP
286	BPROP1 2 0.05520 0.0009700 0.0004850 0.0004850 0.89	BPROP
287	BPROP1 3 50 10000 10000 10000 0.85 0.85	BPROP
288	END	END
289	TRIAB 1 4 9 3 1 1 1.50	TRIAB
290	TRIAB 2 4 13 9 1 1 1.50	TRIAB
291	TRIAB 3 13 12 9 1 1 1.50	TRIAB
292	TRIAB 4 6 14 5 1 1 1.50	TRIAB
293	TRIAB 5 6 15 14 1 1 1.50	TRIAB
294	TRIAB 6 11 16 10 1 1 1.50	TRIAB
295	TRIAB 7 11 17 16 1 1 1.50	TRIAB
296	TRIAB 8 12 17 11 1 1 1.50	TRIAB
297	TRIAB 9 15 20 14 1 1 1.50	TRIAB
298	TRIAB 10 14 20 19 1 1 1.50	TRIAB
299	TRIAB 11 20 25 19 1 1 1.50	TRIAB
300	TRIAB 12 19 25 24 1 1 1.50	TRIAB
301	TRIAB 13 25 26 24 1 1 1.50	TRIAB
302	TRIAB 14 26 23 24 1 1 1.50	TRIAB
303	TRIAB 15 23 18 24 1 1 1.50	TRIAB
304	TRIAB 16 18 19 24 1 1 1.50	TRIAB
305	TRIAB 17 23 26 29 1 1 1.50	TRIAB
306	TRIAB 18 23 29 22 1 1 1.50	TRIAB
307	TRIAB 19 22 29 28 1 1 1.50	TRIAB
308	TRIAB 20 22 28 27 1 1 1.50	TRIAB
309	TRIAB 21 22 27 21 1 1 1.50	TRIAB
310	TRIAB 22 32 4 3 1 1 1.50	TRIAB
311	TRIAB 23 36 4 32 1 1 1.50	TRIAB
312	TRIAB 24 36 32 35 1 1 1.50	TRIAB
313	TRIAB 25 37 6 5 1 1 1.50	TRIAB
314	TRIAB 26 38 6 37 1 1 1.50	TRIAB
315	TRIAB 27 39 34 33 1 1 1.50	TRIAB
316	TRIAB 28 40 34 39 1 1 1.50	TRIAB
317	TRIAB 29 40 35 34 1 1 1.50	TRIAB
318	TRIAB 30 38 37 43 1 1 1.50	TRIAB
319	TRIAB 31 43 37 42 1 1 1.50	TRIAB
320	TRIAB 32 48 43 42 1 1 1.50	TRIAB
321	TRIAB 33 48 42 47 1 1 1.50	TRIAB
322	TRIAB 34 49 48 47 1 1 1.50	TRIAB
323	TRIAB 35 46 49 47 1 1 1.50	TRIAB
324	TRIAB 36 41 46 47 1 1 1.50	TRIAB

*** STARDYNE 3.0 INPUT ***

CARD IMAGE

CARD NO	1 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80	CARD TYPE
325	TRIAB 37 42 41 47 1 1 1.50	TRIAB
326	TRIAB 38 52 49 46 1 1 1.50	TRIAB
327	TRIAB 39 52 46 45 1 1 1.50	TRIAB
328	TRIAB 40 51 52 45 1 1 1.50	TRIAB
329	TRIAB 41 50 51 45 1 1 1.50	TRIAB
330	TRIAB 42 50 45 44 1 1 1.50	TRIAB
331	TRIAB 43 56 61 55 2 1 1.50	TRIAB
332	TRIAB 44 56 65 61 2 1 1.50	TRIAB
333	TRIAB 45 65 64 61 2 1 1.50	TRIAB
334	TRIAB 46 58 66 57 2 1 1.50	TRIAB
335	TRIAB 47 58 67 66 2 1 1.50	TRIAB
336	TRIAB 48 63 68 62 2 1 1.50	TRIAB
337	TRIAB 49 63 69 68 2 1 1.50	TRIAB
338	TRIAB 50 64 69 63 2 1 1.50	TRIAB
339	TRIAB 51 67 72 66 2 1 1.50	TRIAB
340	TRIAB 52 66 72 71 2 1 1.50	TRIAB
341	TRIAB 53 72 77 71 2 1 1.50	TRIAB
342	TRIAB 54 71 77 76 2 1 1.50	TRIAB
343	TRIAB 55 77 78 76 2 1 1.50	TRIAB
344	TRIAB 56 78 75 76 2 1 1.50	TRIAB
345	TRIAB 57 75 70 76 2 1 1.50	TRIAB
346	TRIAB 58 70 71 76 2 1 1.50	TRIAB
347	TRIAB 59 75 78 81 2 1 1.50	TRIAB
348	TRIAB 60 75 81 74 2 1 1.50	TRIAB
349	TRIAB 61 74 81 80 2 1 1.50	TRIAB
350	TRIAB 62 74 80 79 2 1 1.50	TRIAB
351	TRIAB 63 74 79 73 2 1 1.50	TRIAB
352	TRIAB 64 84 56 55 2 1 1.50	TRIAB
353	TRIAB 65 88 56 84 2 1 1.50	TRIAB
354	TRIAB 66 88 84 87 2 1 1.50	TRIAB
355	TRIAB 67 89 58 57 2 1 1.50	TRIAB
356	TRIAB 68 90 58 89 2 1 1.50	TRIAB
357	TRIAB 69 91 86 85 2 1 1.50	TRIAB
358	TRIAB 70 92 86 91 2 1 1.50	TRIAB
359	TRIAB 71 92 87 86 2 1 1.50	TRIAB
360	TRIAB 72 90 89 95 2 1 1.50	TRIAB
361	TRIAB 73 95 89 94 2 1 1.50	TRIAB
362	TRIAB 74 100 95 94 2 1 1.50	TRIAB
363	TRIAB 75 100 94 99 2 1 1.50	TRIAB
364	TRIAB 76 101 100 99 2 1 1.50	TRIAB
365	TRIAB 77 98 101 99 2 1 1.50	TRIAB
366	TRIAB 78 93 98 99 2 1 1.50	TRIAB
367	TRIAB 79 94 93 99 2 1 1.50	TRIAB
368	TRIAB 80 104 101 98 2 1 1.50	TRIAB
369	TRIAB 81 104 98 97 2 1 1.50	TRIAB
370	TRIAB 82 103 104 97 2 1 1.50	TRIAB
371	TRIAB 83 102 103 97 2 1 1.50	TRIAB
372	TRIAB 84 102 97 96 2 1 1.50	TRIAB
373	END	END
374	QUADB 1 2 8 7 1 1 1 1.50	QUADB
375	QUADB 2 3 9 8 2 1 1 1.50	QUADB
376	QUADB 3 5 14 13 4 1 1 1.50	QUADB
377	QUADB 4 8 11 10 7 1 1 1.50	QUADB
378	QUADB 5 9 12 11 8 1 1 1.50	QUADB

CARD IMAGE

CARD NO	1 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80	CARD TYPE
379	QUAD8 6 13 18 17 12 1 1 1.50	QUAD8
380	QUAD8 7 14 19 18 13 1 1 1.50	QUAD8
381	QUAD8 8 17 22 21 16 1 1 1.50	QUAD8
382	QUAD8 9 18 23 22 17 1 1 1.50	QUAD8
383	QUAD8 10 31 2 1 30 1 1 1.50	QUAD8
384	QUAD8 11 32 3 2 31 1 1 1.50	QUAD8
385	QUAD8 12 34 31 30 33 1 1 1.50	QUAD8
386	QUAD8 13 35 32 31 34 1 1 1.50	QUAD8
387	QUAD8 14 37 5 4 36 1 1 1.50	QUAD8
388	QUAD8 15 41 36 35 40 1 1 1.50	QUAD8
389	QUAD8 16 42 37 36 41 1 1 1.50	QUAD8
390	QUAD8 17 45 40 39 44 1 1 1.50	QUAD8
391	QUAD8 18 46 41 40 45 1 1 1.50	QUAD8
392	QUAD8 19 54 60 59 53 2 1 1.50	QUAD8
393	QUAD8 20 55 61 60 54 2 1 1.50	QUAD8
394	QUAD8 21 57 66 65 56 2 1 1.50	QUAD8
395	QUAD8 22 60 63 62 59 2 1 1.50	QUAD8
396	QUAD8 23 61 64 63 60 2 1 1.50	QUAD8
397	QUAD8 24 65 70 69 64 2 1 1.50	QUAD8
398	QUAD8 25 66 71 70 65 2 1 1.50	QUAD8
399	QUAD8 26 69 74 73 68 2 1 1.50	QUAD8
400	QUAD8 27 70 75 74 69 2 1 1.50	QUAD8
401	QUAD8 28 83 54 53 82 2 1 1.50	QUAD8
402	QUAD8 29 84 55 54 83 2 1 1.50	QUAD8
403	QUAD8 30 86 83 82 85 2 1 1.50	QUAD8
404	QUAD8 31 87 84 83 86 2 1 1.50	QUAD8
405	QUAD8 32 89 57 56 88 2 1 1.50	QUAD8
406	QUAD8 33 93 88 87 92 2 1 1.50	QUAD8
407	QUAD8 34 94 89 88 93 2 1 1.50	QUAD8
408	QUAD8 35 97 92 91 96 2 1 1.50	QUAD8
409	QUAD8 36 98 93 92 97 2 1 1.50	QUAD8
410	QUAD8 37 106 51 50 105 1 1 0.50	QUAD8
411	QUAD8 38 107 52 51 106 1 1 0.50	QUAD8
412	QUAD8 39 108 49 52 107 1 1 0.50	QUAD8
413	QUAD8 40 109 48 49 108 1 1 0.50	QUAD8
414	QUAD8 41 110 43 48 109 1 1 0.50	QUAD8
415	QUAD8 42 111 38 43 110 1 1 0.50	QUAD8
416	QUAD8 43 112 6 38 111 1 1 0.50	QUAD8
417	QUAD8 44 113 15 6 112 1 1 0.50	QUAD8
418	QUAD8 45 114 20 15 113 1 1 0.50	QUAD8
419	QUAD8 46 115 25 20 114 1 1 0.50	QUAD8
420	QUAD8 47 116 26 25 115 1 1 0.50	QUAD8
421	QUAD8 48 117 29 26 116 1 1 0.50	QUAD8
422	QUAD8 49 118 28 29 117 1 1 0.50	QUAD8
423	QUAD8 50 119 27 28 118 1 1 0.50	QUAD8
424	QUAD8 51 103 106 105 102 1 1 0.50	QUAD8
425	QUAD8 52 104 107 106 103 1 1 0.50	QUAD8
426	QUAD8 53 101 108 107 104 1 1 0.50	QUAD8
427	QUAD8 54 100 109 108 101 1 1 0.50	QUAD8
428	QUAD8 55 95 110 109 100 1 1 0.50	QUAD8
429	QUAD8 56 90 111 110 95 1 1 0.50	QUAD8
430	QUAD8 57 58 112 111 90 1 1 0.50	QUAD8
431	QUAD8 58 67 113 112 58 1 1 0.50	QUAD8
432	QUAD8 59 72 114 113 67 1 1 0.50	QUAD8

CARD IMAGE

CARD NO																					
	1	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
433	QUADB		60		77		115		114		72		1	1		0.50					
434	QUADB		61		78		116		115		77		1	1		0.50					
435	QUADB		62		81		117		116		78		1	1		0.50					
436	QUADB		63		80		118		117		81		1	1		0.50					
437	QUADB		64		79		119		118		80		1	1		0.50					
438	QUADB		79		330		331		316		315		1			.5000					
439	QUADB		80		331		332		317		316		1			.5000					
440	QUADB		81		332		333		318		317		1			.5000					
441	QUADB		82		333		334		319		318		1			.5000					
442	QUADB		83		334		335		320		319		1			.5000					
443	QUADB		84		335		336		321		320		1			.5000					
444	QUADB		85		336		337		322		321		1			.5000					
445	QUADB		86		337		338		323		322		1			.5000					
446	QUADB		87		338		339		324		323		1			.5000					
447	QUADB		88		339		340		325		324		1			.5000					
448	QUADB		89		340		341		326		325		1			.5000					
449	QUADB		90		341		342		327		326		1			.5000					
450	QUADB		91		342		343		328		327		1			.5000					
451	QUADB		92		343		344		329		328		1			.5000					
452	QUADB		93		345		346		331		330		1			.5000					
453	QUADB		94		346		347		332		331		1			.5000					
454	QUADB		95		347		348		333		332		1			.5000					
455	QUADB		96		348		349		334		333		1			.5000					
456	QUADB		97		349		350		335		334		1			.5000					
457	QUADB		98		350		351		336		335		1			.5000					
458	QUADB		99		351		352		337		336		1			.5000					
459	QUADB		100		352		353		338		337		1			.5000					
460	QUADB		101		353		354		339		338		1			.5000					
461	QUADB		102		354		355		340		339		1			.5000					
462	QUADB		103		355		356		341		340		1			.5000					
463	QUADB		104		356		357		342		341		1			.5000					
464	QUADB		105		357		358		343		342		1			.5000					
465	QUADB		106		358		359		344		343		1			.5000					
466	QUADB		107		360		361		346		345		1			.5000					
467	QUADB		108		361		362		347		346		1			.5000					
468	QUADB		109		362		363		348		347		1			.5000					
469	QUADB		110		363		364		349		348		1			.5000					
470	QUADB		111		364		365		350		349		1			.5000					
471	QUADB		112		365		366		351		350		1			.5000					
472	QUADB		113		366		367		352		351		1			.5000					
473	QUADB		114		367		368		353		352		1			.5000					
474	QUADB		115		368		369		354		353		1			.5000					
475	QUADB		116		369		370		355		354		1			.5000					
476	QUADB		117		370		371		356		355		1			.5000					
477	QUADB		118		371		372		357		356		1			.5000					
478	QUADB		119		372		373		358		357		1			.5000					
479	QUADB		120		373		374		359		358		1			.5000					
480	QUADB		121		401		402		374		373		1			.5000					
481	QUADB		122		400		401		373		372		1			.5000					
482	QUADB		123		399		400		372		371		1			.5000					
483	QUADB		124		398		399		371		370		1			.5000					
484	QUADB		125		397		398		370		369		1			.5000					
485	QUADB		126		396		397		369		368		1			.5000					
486	QUADB		127		395		396		368		367		1			.5000					

CARD TYPE

QUADB

*** STARDYNE 3.0 INPUT ***

CARD IMAGE

```
                1   4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80
                *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
CARD NO.        ********************************************************************************  CARD TYPE
      487       QUADB     128     .394     395     367     366       1      .5000                  QUADB
      488       QUADB     129     393      394     366     365       1      .5000                  QUADB
      489       QUADB     130     392      393     365     364       1      .5000                  QUADB
      490       QUADB     131     391      392     364     363       1      .5000                  QUADB
      491       QUADB     132     390      391     363     362       1      .5000                  QUADB
      492       QUADB     133     389      390     362     361       1      .5000                  QUADB
      493       QUADB     134     388      389     361     360       1      .5000                  QUADB
      494       END                                                                               END
      495       ENDGEOM                                                                           ENDGE
      496        STRESS ANALYSIS LEAD PLUG AND CANISTER                                            STRE
      497       STATIC                                                                            STATI
      498        LOAD CASE 3 FIVE FOOT DROP 48 G                                                   LOAD
      499       ACCEL      -1                              -48.0                                  ACCEL
      500       END                                                                               END
      501       END CASE                                                                          END C
      502       ALL DONE                                                                          ALL D
      503       OPTION                                                                            OPTIO
      504       OUTPUT         1          2 2  2      2                                          OUTPU
      505       TAPE4G         1                             1  111                              TAPE4
      506       ENDMODEL                                                                          ENDMO
```

```
*****************************************
*                                       *
*        T R S    T A P E    I N F O    *
*                                       *
*                 NU1072W               *
*                                       *
*  SYM         : AJMIILI    VSN    : A00927
*  FN          :     1      RN     :     1
*  APW         :            WPW    : ADV
*  DATE READ   :            NO R   :     0
*  DATE WRIT   :            NO W   :     0
*  DATE CERT   :            NO C   :     0
*  DATE ACQ    : 84/09/24   CT     : PU
*  RP          :            PO     :
*  F           :            FA     :
*  TR          :            D      :
*  LB          :            CV     :
*  ALTVSN      :            WPO    :
*  W           : W          FLAGS  : L/U/N
*  L           : DISK249S
*  COM         :
*                                       *
*****************************************
```

```
11.57.21.BWF,P3,T700.
11.57.22.USER,NU1072w,.
11.57.22.CHARGE,F3395JT,*046*.
11.57.22.ROUTE,OUTPUT,DC=PR,DEF,FID=BWF27.
11.57.22. ROUTE COMPLETE.
11.57.22.TRS,LFN=BF,R,OP=R,SYM=AJMIIIa
11.57.25.$LABEL(BF,PO=R,L=$DISK2495                $,VSN=A00927)
12.02.53.NT32, ASSIGNED TO BF        , VSN=A00927.
12.02.53.SKIPF,BF,2,8.
12.02.54.COPYBF,BF,TAPE4.
12.02.55. COPY COMPLETE.
12.02.55.REWIND,TAPE4.
12.02.55.GET,APPLIC/UN=LIBRARY.
12.02.56.BEGIN,POST4,APPLIC.
12.02.58.$BEGIN,LOGO,APPLIC,INPUT,POST4,$1.2.06.
12.03.01.RETURN,LOGO,QABLK2.
12.03.01.ATTACH,LOGO/UN=LIBRARY,M=E,PW=.
12.03.01.LOGO.      POST4,1.2.0
12.03.02.      END  LOGO
12.03.02.     020600 MAXIMUM EXECUTION FL.
12.03.02.      0.145 CP SECONDS EXECUTION TIME.
12.03.02.RETURN,LOGO.
12.03.02.ATTACH,QABLK2/UN=LIBRARY,M=E,PW=.
12.03.02.QABLK2.      POST4,1.2.0
12.03.03.     STOP
12.03.03.     022300 MAXIMUM EXECUTION FL.
12.03.03.      0.147 CP SECONDS EXECUTION TIME.
12.03.03.RETURN,QABLK2.
12.03.03.REVERT.
12.03.03.$RETURN,OLA.
12.03.03.$ATTACH,OLA=OLA4/UN=LIBRARY,M=E,PW=.
12.03.03.$REWIND,OLA.
12.03.03.$REVERT.     POST4 ATTACHED (LFN=OLA)
12.03.04.OLA,PL=99999.
12.03.05. START APPLICATION  OPT2
12.03.05. * * *   P O S T 4   * * *
12.03.05. *      VERSION  1.2       *
12.03.05. * *     LEVEL 07JAN82     *
12.03.11. * *  E N D  P O S T 4  * *
12.03.12.     STOP
12.03.12.     121500    FINAL EXECUTION FL.
12.03.12.      4.252 CP SECONDS EXECUTION TIME.
12.03.12. REPRIEVED NORMAL TERMINATION.
12.03.12. JOB REPRIEVED.
12.03.12.      2.701 SRUS USED BY APPLICATION
12.03.12. RPV - PREVIOUS ERROR CONDITIONS RESET.
12.03.12.RETURN,BF.
12.03.12.GOTO,1.
12.03.12.1,DAYFILE,DAY.
12.03.12. USER DAYFILE PROCESSED.
12.03.12.REPLACE,DAY.
12.03.13.UEAD,        0.003KUNS.
12.03.13.UEPF,        0.186KUNS.
12.03.13.UEMT,        0.125KUNS.
12.03.13.UEMS,       10.068KUNS.
12.03.13.UECP,        5.438SECS.
12.03.13.AESR,        8.348UNTS.
12.03.50.UCLP, AA21,        1.045KLNS.
```

```
                              * * *  POST4      1.2       INPUT  * * *

                    /-----------------------------------,,CARD IMAGE  ----------------------------------/
                    1   5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
                    *   *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *
CARD NO  ***********************************************************************************************

      1  TITLE     BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES
      2  SEL-VECTORSG    1    1    1
      3  SEL-IPLTSTSG    1   84    1
      4  SEL-RPLTSTSG    1  120    1
      5  SEL-BEAMSTSG    1   32    1
      6  LIST      1     1    1    2    3    4    5    6   10   11   12
      7  WRITE70
```

```
POST4 *** BOTTOM END PLUG 5 FOOT GROUP STRESS INTENSITIES                    ***

SCALE FACTOR =  .1000E+01
FLAG TO WRITE TAPE70 = 1


SELECTED LIST OPTIONS =     1    2    3    4    5    6   10   11   12    8    9


OPTION = 1      SXP     NORMAL STRESS - LOCAL X - + FACE
       = 2      SYP     NORMAL STRESS - LOCAL Y - + FACE
       = 3     SXYP     SHEAR STRESS - LOCAL XY - + FACE
       = 4      SXN     NORMAL STRESS - LOCAL X - - FACE
       = 5      SYN     NORMAL STRESS - LOCAL Y - - FACE
       = 6     SXYN     SHEAR STRESS - LOCAL XY - - FACE
       = 7      SXM     MEMBRANE NORMAL STRESS - LOCAL X
       = 8      SYM     MEMBRANE NORMAL STRESS - LOCAL Y
       = 9     SXYM     MEMBRANE SHEAR STRESS - LOCAL XY
       = 10     SIP     STRESS INTENSITY - + FACE
       = 11     SIN     STRESS INTENSITY - - FACE
       = 12     SIM     MEMBRANE STRESS INTENSITY
       = 13     S1P     MAXIMUM PRINCIPAL STRESS - + FACE
       = 14     S2P     MINIMUM PRINCIPAL STRESS - + FACE
       = 15     S3P     PRINCIPAL STRESS DIFF. - + FACE
       = 16     S1N     MAXIMUM PRINCIPAL STRESS - - FACE
       = 17     S2N     MINIMUM PRINCIPAL STRESS - - FACE
       = 18     S3N     PRINCIPAL STRESS DIFF. - FACE
       = 19     S1M     MAXIMUM MEMBRANE STRESS
       = 20     S2M     MINIMUM MEMBRANE STRESS
       = 21     S3M     MEMBRANE PRINCIPAL STRESS DIFF.
       = 22   S12MAXP   MAX. ABS. PRINCIPAL STRESS - + FACE
       = 23   S12MAXN   MAX. ABS. PRINCIPAL STRESS - - FACE
       = 24   S12MAXM   MAX. ABS. MEMBRANE STRESS
       = 25   SIMAXEF   MAX. OF MAX. STRESS INTEN. - E.F.
       = 26   S1MAXEF   MAX. OF MAX. PRIN. STRESSES - E.F.
       = 27   S1MINEF   MIN. OF MAX. PRIN. STRESSES - E.F.
       = 28   S2MAXEF   MAX. OF MIN. PRIN. STRESSES - E.F.
       = 29   S2MINEF   MIN. OF MIN. PRIN. STRESSES - E.F.
       = 30  S12AMAXEF  MAX. OF ABS. MAX. PRINCIPAL STRESSES
       = 31  S2AMAXEF   MAX. OF ABS. MIN. PRINCIPAL STRESSES
       = 32    THETAM   AXIS ANGLE OF PRIN. MEMB. STRESSES
       = 33      SXB    BENDING STRESS - LOCAL X
       = 34      SYB    BENDING STRESS - LOCAL Y
       = 35      SXZ    TRANSVERSE SHEAR XZ
       = 36      SYZ    TRANSVERSE SHEAR YZ


FLAG TO PRINT VECTORS =     1
OUTPUT FORMAT FOR LIST OPTION =     1
          FORMAT 1 = (1X,I4,5X,1P,11(E10.3,1X))
          FORMAT 2 = (1X,I4,5X,11(F10.0,1X))
          FORMAT 3 = (1X,I4,5X,11(F10.4,1X))
```

BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES
LOAD CASE 3 FIVE FOOT DROP 48 G

BEAMSTS ELEM	PB/A -PA/A	VA2/KA	VA3/KA	MA2C/I	MA3C/I	TBC/J -TAC/J	VB2/KA	VB3/KA	MB2C/I	MB3C/I
1	-3.249E+05	-3.758E+02	-2.006E+02	-7.482E+04	-1.572E+05	0.	-3.758E+02	-2.006E+02	3.692E+04	7.807E+04
2	-3.250E+05	-3.760E+02	2.000E+02	7.464E+04	-1.572E+05	0.	-3.760E+02	2.000E+02	-3.678E+04	7.810E+04
3	-3.711E+05	0.	-4.428E+02	-1.653E+05	0.	0.	0.	-4.428E+02	8.143E+04	0.
4	-3.708E+05	0.	4.434E+02	1.655E+05	0.	0.	0.	4.434E+02	-8.159E+04	0.
18	5.260E+00	1.090E+02	5.134E+01	5.148E-02	1.146E-01	-1.941E-02	1.090E+02	5.134E+01	-5.763E-02	-1.170E-01
19	9.080E+00	2.196E+02	7.072E+00	8.898E-03	2.303E-01	-8.242E-02	2.196E+02	7.072E+00	-6.625E-03	-2.519E-01
20	1.924E+01	1.082E+02	-1.837E+01	-1.475E-02	1.733E-01	-1.158E-01	1.082E+02	-1.837E+01	3.034E-02	-9.233E-02
21	1.737E+00	5.981E+01	7.337E+00	7.574E-03	1.095E-01	-1.186E-01	5.981E+01	7.337E+00	-1.240E-02	-5.331E-02
22	9.478E+00	3.403E+01	2.770E+00	1.240E-02	1.139E-01	-1.787E-01	3.403E+01	2.770E+00	3.496E-03	4.483E-03
23	1.548E+01	9.538E+01	9.971E+00	-2.638E-03	1.897E-01	1.392E-01	9.538E+01	9.971E+00	-2.711E-02	-4.441E-02
24	8.766E+00	2.133E+02	-4.469E+00	-4.424E-03	2.194E-01	7.795E-02	2.133E+02	-4.469E+00	5.385E-03	-2.489E-01
25	1.068E+01	2.131E+02	-9.848E-02	-1.058E-04	2.243E-01	9.597E-06	2.131E+02	-9.848E-02	1.034E-04	-2.286E-01
26	8.782E+00	2.132E+02	4.262E+00	4.197E-03	2.192E-01	-7.789E-02	2.132E+02	4.262E+00	-5.158E-03	-2.488E-01
27	1.551E+01	9.535E+01	-1.016E+01	2.378E-03	1.895E-01	-1.390E-01	9.535E+01	-1.016E+01	2.733E-02	-4.456E-02
28	8.443E+00	3.395E+01	-2.591E+00	-1.214E-02	1.135E-01	1.781E-01	3.395E+01	-2.591E+00	-3.817E-03	4.354E-03
29	1.974E+00	5.959E+01	-6.479E+00	-6.508E-03	1.087E-01	1.177E-01	5.959E+01	-6.479E+00	1.113E-02	-5.355E-02
30	1.947E+01	1.079E+02	2.048E+01	1.725E-02	1.721E-01	1.148E-01	1.079E+02	2.048E+01	-3.300E-02	-9.260E-02
31	9.493E+00	2.179E+02	-4.400E+00	-5.795E-03	2.305E-01	8.212E-02	2.179E+02	-4.400E+00	3.864E-03	-2.480E-01
32	5.513E+00	1.222E+02	0.	0.	1.160E-01	0.	1.222E+02	0.	0.	-1.437E-01
MAXIMUM	1.947E+01	2.196E+02	4.434E+02	1.655E+05	2.305E-01	1.781E-01	2.196E+02	4.434E+02	8.143E+04	7.810E+04
ELEMENT	30	19	4	4	31	28	19	4	3	2
	0.					0.				
	1					1				
MINIMUM	-3.711E+05	-3.760E+02	-4.428E+02	-1.653E+05	-1.572E+05	-1.787E-01	-3.760E+02	-4.428E+02	-8.159E+04	-2.519E-01
ELEMENT	3	2	3	3	2	22	2	3	4	19
	0.					0.				
	1					1				

BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES
LOAD CASE 3 FIVE FOOT DROP 48 G

TPLTSTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
1	3.563E+02	3.702E+02	-1.566E+01	3.983E+02	4.087E+02	-1.088E+00	3.803E+02	4.088E+02	3.937E+02	3.894E+02	-8.375E+00
2	3.373E+02	3.539E+02	-1.108E+00	3.953E+02	3.982E+02	-2.996E+00	3.874E+02	4.001E+02	3.916E+02	3.760E+02	-2.052E+00
3	3.529E+02	4.057E+02	2.465E+00	4.041E+02	3.797E+02	-1.792E+00	4.058E+02	4.042E+02	3.927E+02	3.927E+02	3.464E-01
4	2.588E+02	2.826E+02	-5.402E+01	5.049E+02	4.709E+02	6.429E+01	3.260E+02	5.544E+02	3.850E+02	3.767E+02	5.133E+00
5	2.015E+02	7.879E+01	4.152E+01	5.522E+02	6.792E+02	-3.387E+01	2.142E+02	6.877E+02	3.819E+02	3.790E+02	3.821E+00
6	3.636E+02	3.589E+02	4.720E+00	4.163E+02	4.057E+02	-1.537E+01	3.665E+02	4.272E+02	3.927E+02	3.823E+02	-5.324E+00
7	3.756E+02	3.761E+02	-5.785E+00	4.068E+02	3.937E+02	1.349E+01	3.816E+02	4.152E+02	3.930E+02	3.849E+02	3.852E+00
8	3.733E+02	3.960E+02	-2.265E+00	4.121E+02	3.640E+02	1.605E+00	3.962E+02	4.121E+02	3.927E+02	3.800E+02	-3.300E-01
9	9.768E+01	3.946E+01	1.445E+01	4.946E+02	7.034E+02	-1.656E+01	1.011E+02	7.047E+02	3.714E+02	3.714E+02	-1.051E+00
10	8.356E+01	1.784E+02	1.572E+02	6.411E+02	6.778E+02	-1.482E+02	3.283E+02	8.087E+02	4.284E+02	4.281E+02	4.507E+00
11	6.958E+02	-1.749E+02	-1.726E+00	2.475E+02	9.121E+02	5.272E+01	8.707E+02	9.163E+02	4.776E+02	3.686E+02	2.550E+01
12	2.704E+02	-3.290E+02	3.494E+02	5.441E+02	1.147E+03	-3.009E+02	9.206E+02	1.271E+03	4.323E+02	4.089E+02	2.423E+01
13	-6.039E+01	-5.354E+02	-1.823E+02	7.823E+02	1.281E+03	2.148E+02	5.988E+02	1.361E+03	3.841E+02	3.728E+02	1.625E+01
14	1.797E+02	1.540E+02	-2.979E+02	6.911E+02	6.036E+02	1.982E+02	5.963E+02	8.504E+02	4.644E+02	3.788E+02	-4.983E+01
15	6.372E+02	7.777E+02	-1.915E+00	2.153E+02	3.273E+01	7.881E+01	7.777E+02	2.446E+02	4.556E+02	4.052E+02	3.845E+01
16	6.111E+02	7.194E+02	2.462E+01	2.035E+02	6.087E+01	-8.319E+01	7.247E+02	2.417E+02	4.292E+02	3.901E+02	-2.928E+01
17	1.783E+02	1.492E+02	-2.826E+02	7.680E+02	8.598E+02	4.754E+01	5.660E+02	8.800E+02	6.074E+02	5.045E+02	-1.175E+02
18	9.359E+01	2.389E+02	1.385E+02	8.040E+02	5.445E+02	-5.344E+01	3.227E+02	8.146E+02	4.715E+02	3.917E+02	4.254E+01
19	9.745E+01	1.226E+02	-4.307E+01	5.725E+02	5.828E+02	1.217E+02	1.549E+02	6.994E+02	3.841E+02	3.527E+02	3.930E+01
20	1.079E+02	1.924E+02	5.790E+01	6.933E+02	5.834E+02	-5.283E+01	2.218E+02	7.146E+02	4.011E+02	3.879E+02	2.538E+00
21	2.692E+02	2.861E+02	5.071E+01	5.192E+02	4.834E+02	-6.954E+01	3.290E+02	5.731E+02	4.000E+02	3.847E+02	-9.417E+00
22	3.546E+02	3.717E+02	1.444E+01	3.965E+02	4.104E+02	-2.670E-01	3.799E+02	4.104E+02	3.938E+02	3.910E+02	7.085E+00
23	3.883E+02	3.534E+02	2.760E+00	3.961E+02	3.974E+02	4.633E+00	3.885E+02	4.014E+02	3.929E+02	3.754E+02	3.697E+00
24	3.660E+02	3.906E+02	-2.383E+01	3.987E+02	3.853E+02	8.797E+00	4.051E+02	4.030E+02	3.932E+02	3.879E+02	-7.514E+00
25	2.640E+02	2.802E+02	5.455E+01	5.100E+02	4.685E+02	-6.376E+01	3.272E+02	5.563E+02	3.885E+02	3.743E+02	-4.602E+00
26	2.040E+02	7.908E+01	-4.513E+01	5.545E+02	6.792E+02	3.020E+01	2.186E+02	6.861E+02	3.867E+02	3.791E+02	-7.459E+00
27	3.617E+02	3.581E+02	-4.116E+00	4.107E+02	4.026E+02	1.438E+01	3.644E+02	4.216E+02	3.892E+02	3.803E+02	5.130E+00
28	3.740E+02	3.697E+02	4.191E+00	4.038E+02	3.866E+02	-1.319E+01	3.765E+02	4.109E+02	3.905E+02	3.782E+02	-4.498E+00
29	3.733E+02	3.940E+02	2.452E+00	4.080E+02	3.615E+02	3.569E-01	3.942E+02	4.080E+02	3.908E+02	3.777E+02	1.404E+00
30	6.076E+01	8.450E+01	3.667E+01	6.628E+02	5.421E+02	-7.980E+01	1.112E+02	7.025E+02	3.700E+02	3.133E+02	-2.157E+01
31	8.606E+01	1.897E+02	-1.631E+02	6.428E+02	6.882E+02	1.417E+02	3.423E+02	8.091E+02	4.404E+02	4.389E+02	-1.070E+01
32	7.139E+02	-1.777E+02	-4.557E-01	2.671E+02	9.067E+02	-5.510E+01	8.917E+02	9.115E+02	4.964E+02	3.645E+02	-2.778E+01
33	2.808E+02	-3.182E+02	-3.572E+02	5.527E+07	1.151E+03	2.910E+02	9.323E+02	1.269E+03	4.496E+02	4.163E+02	-3.308E+01
34	-2.615E+01	-5.335E+02	1.846E+02	8.119E+02	1.276E+03	-2.106E+02	6.274E+02	1.358E+03	3.990E+02	3.715E+02	-1.303E+01
35	1.753E+02	1.702E+02	3.054E+02	6.941E+02	6.210E+02	-1.884E+02	6.116E+02	8.495E+02	4.770E+02	3.956E+02	5.869E+01
36	6.474E+02	7.802E+02	-7.651E+00	2.280E+02	4.227E+01	-8.937E+01	7.806E+02	2.640E+02	4.748E+02	4.112E+02	-4.851E+01
37	6.115E+02	7.327E+02	-1.481E+01	2.050E+02	7.550E+01	9.213E+01	7.345E+02	2.529E+02	4.449E+02	4.041E+02	3.866E+01
38	4.719E+02	-1.284E+02	4.202E+01	7.931E+02	8.578E+02	4.963E+01	6.061E+02	8.847E+02	6.401E+02	3.647E+02	4.583E+01
39	1.068E+02	2.336E+02	-1.570E+02	8.096E+02	5.224E+02	3.183E+01	3.395E+02	8.131E+02	4.924E+02	3.780E+02	-6.258E+01
40	1.474E+02	7.803E+01	3.216E+01	4.380E+02	6.930E+02	2.516E+01	1.601E+02	6.955E+02	3.937E+02	3.855E+02	2.866E+01
41	1.450E+02	9.412E+01	7.600E+01	5.042E+02	7.026E+02	-3.388E+01	1.997E+02	7.082E+02	4.039E+02	3.984E+02	2.106E+01
42	2.855E+02	3.255E+02	-1.059E+01	4.664E+02	4.189E+02	5.524E+01	3.281E+02	5.028E+02	3.965E+02	3.722E+02	2.232E+01
43	2.384E+04	2.923E+04	-4.265E+03	-2.454E+04	-2.997E+04	4.275E+03	3.158E+04	3.232E+04	3.729E+02	-3.718E+02	5.205E+00
44	2.252E+04	1.806E+04	2.508E+03	-2.326E+04	-1.876E+04	-2.493E+03	2.365E+04	2.437E+04	3.723E+02	-3.508E+02	7.830E+00
45	1.982E+04	2.558E+04	-3.641E+03	-2.052E+04	-2.632E+04	3.627E+03	2.734E+04	2.806E+04	3.717E+02	-3.692E+02	-6.972E+00
46	4.204E+03	1.240E+03	-8.006E+03	-4.912E+03	-1.953E+03	7.995E+03	1.628E+04	1.626E+04	3.606E+02	-3.563E+02	-5.365E+00
47	5.500E+03	-8.243E+03	1.647E+03	-6.190E+03	7.532E+03	-1.654E+03	1.413E+04	1.412E+04	3.565E+02	-3.556E+02	-3.118E+00
48	2.260E+04	2.683E+04	4.037E+03	-2.331E+04	-2.754E+04	-4.026E+03	2.927E+04	2.998E+04	3.630E+02	-3.555E+02	5.299E+00
49	1.515E+04	2.252E+04	9.948E+01	-1.588E+04	-2.303E+04	-1.064E+02	2.232E+04	2.303E+04	3.654E+02	-3.515E+02	-3.469E+00
50	2.065E+04	3.026E+04	5.401E+03	-2.138E+04	-3.096E+04	-5.393E+03	3.268E+04	3.339E+04	3.650E+02	-3.523E+02	3.743E+00
51	5.200E+03	-9.943E+03	-4.961E+02	-5.739E+03	9.246E+03	4.952E+02	1.517E+04	1.502E+04	3.484E+02	-3.484E+02	-4.882E-01

BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES

BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES
LOAD CASE 3 FIVE FOOT DROP 45 G

TPLFSTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
52	-1.501E+03	-2.344E+03	8.552E+03	8.238E+02	1.518E+03	-8.582E+03	1.712E+04	1.718E+04	4.162E+02	-4.132E+02	-1.517E+01
53	2.399E+01	-1.439E+04	-1.074E+03	-9.965E+02	1.371E+04	1.032E+03	1.457E+04	1.485E+04	4.892E+02	-3.414E+02	-2.099E+01
54	-1.793E+03	-3.809E+03	8.166E+03	9.725E+02	3.038E+03	-8.214E+03	1.646E+04	1.656E+04	4.247E+02	-3.855E+02	-2.381E+01
55	5.541E+03	-1.272E+04	-5.156E+02	-6.276E+03	1.200E+04	5.092E+02	1.829E+04	1.831E+04	3.684E+02	-3.556E+02	-3.209E+00
56	-2.261E+03	-3.962E+02	-8.706E+03	1.472E+03	-3.599E+02	8.991E+03	1.791E+04	1.807E+04	4.296E+02	-3.780E+02	4.259E+01
57	4.834E+03	4.770E+03	5.609E+03	-5.643E+03	-5.535E+03	-5.682E+03	1.122E+04	1.136E+04	4.313E+02	-3.826E+02	-3.612E+01
58	1.730E+03	5.019E+03	-4.841E+03	-2.496E+03	-5.790E+03	4.903E+03	1.022E+04	1.034E+04	4.154E+02	-3.858E+02	3.113E+01
59	-4.239E+03	-6.989E+03	-7.914E+03	3.395E+03	6.049E+03	8.127E+03	1.606E+04	1.647E+04	5.553E+02	-4.703E+02	1.064E+02
60	-5.715E+03	6.811E+03	6.178E+03	4.876E+03	-7.505E+03	-6.277E+03	1.759E+04	1.763E+04	4.443E+02	-3.469E+02	-4.944E+01
61	-7.659E+01	-2.738E+03	-7.653E+03	-5.055E+02	2.063E+03	7.565E+03	1.553E+04	1.535E+04	3.639E+02	-3.377E+02	-4.376E+01
62	-7.579E+03	5.060E+03	2.676E+03	6.834E+03	-5.652E+03	-2.686E+03	1.372E+04	1.360E+04	3.704E+02	-2.961E+02	-5.392E+00
63	3.567E+03	1.691E+03	7.669E+03	-4.248E+03	-2.378E+03	-7.635E+03	1.545E+04	1.538E+04	3.589E+02	-3.437E+02	1.675E+01
64	2.383E+04	2.925E+04	4.253E+03	-2.454E+04	-2.998E+04	-4.277E+03	3.158E+04	3.233E+04	3.735E+02	-3.648E+02	-1.190E+01
65	2.252E+04	1.806E+04	-2.489E+03	-2.326E+04	-1.877E+04	2.490E+03	2.363E+04	2.437E+04	3.706E+02	-3.537E+02	8.352E-01
66	1.808E+04	2.733E+04	-1.334E+02	-1.879E+04	-2.807E+04	1.417E+02	2.733E+04	2.808E+04	3.733E+02	-3.722E+02	4.136E+00
67	4.191E+03	1.759E+03	8.009E+03	-4.917E+03	-1.949E+03	-7.996E+03	1.628E+04	1.626E+04	3.651E+02	-3.451E+02	6.504E+00
68	5.500E+03	-8.249E+03	-1.633E+03	-6.190E+03	7.531E+03	1.659E+03	1.413E+04	1.412E+04	3.667E+02	-3.592E+02	1.273E+01
69	2.261E+04	2.685E+04	-4.034E+03	-2.335E+04	-2.757E+04	4.022E+03	2.928E+04	3.000E+04	3.762E+02	-3.621E+02	-6.077E+00
70	1.518E+04	2.234E+04	-9.514E+01	-1.592E+04	-2.307E+04	1.066E+02	2.234E+04	2.307E+04	3.752E+02	-3.675E+02	5.722E+00
71	2.066E+04	3.027E+04	-5.388E+03	-2.141E+04	-3.099E+04	5.392E+03	3.269E+04	3.341E+04	3.745E+02	-3.608E+02	1.872E+00
72	-8.070E+03	3.331E+03	5.007E+03	7.385E+03	-3.881E+03	-4.966E+03	1.517E+04	1.502E+04	3.477E+02	-2.750E+02	2.022E+01
73	-1.487E+03	-2.366E+03	-8.553E+03	8.254E+02	1.511E+03	8.584E+03	1.713E+04	1.718E+04	4.299E+02	-4.275E+02	1.548E+01
74	1.199E+01	-1.440E+04	1.087E+03	-9.914E+02	1.371E+04	-1.026E+03	1.457E+04	1.485E+04	4.958E+02	-3.411E+02	3.079E+01
75	-1.793E+03	-3.837E+03	-8.161E+03	9.829E+02	3.033E+03	8.222E+03	1.645E+04	1.657E+04	4.340E+02	-4.016E+02	3.066E+01
76	5.531E+03	-1.274E+04	5.258E+02	-6.285E+03	1.203E+04	-4.965E+02	1.830E+04	1.834E+04	3.840E+02	-3.530E+02	1.461E+01
77	-2.293E+03	-3.997E+02	8.919E+03	1.472E+03	-3.462E+02	-9.026E+03	1.794E+04	1.814E+04	4.483E+02	-3.729E+02	-5.343E+01
78	4.864E+03	4.765E+03	-5.609E+03	-5.666E+03	-5.562E+03	5.697E+03	1.122E+04	1.140E+04	4.440E+02	-3.983E+02	4.423E+01
79	1.706E+03	5.033E+03	4.831E+03	-2.502E+03	-5.793E+03	-4.908E+03	1.022E+04	1.035E+04	4.283E+02	-3.801E+02	-3.841E+01
80	2.445E+03	-1.366E+04	-1.524E+02	-3.570E+03	1.297E+04	8.917E+01	1.611E+04	1.654E+04	5.671E+02	-3.473E+02	-3.161E+01
81	-5.687E+03	6.803E+03	-6.203E+03	4.847E+03	-7.545E+03	6.313E+03	1.760E+04	1.769E+04	4.554E+02	-3.709E+02	5.471E+01
82	6.387E+03	-8.959E+03	-1.071E+03	-6.999E+03	8.224E+03	1.025E+03	1.549E+04	1.536E+04	3.751E+02	-3.674E+02	-2.316E+01
83	5.457E+03	-7.928E+03	1.096E+03	-6.198E+03	7.137E+03	-1.097E+03	1.356E+04	1.351E+04	3.962E+02	-3.954E+02	-4.406E+00
84	3.719E+03	1.852E+03	-7.568E+03	-4.478E+03	-2.591E+03	7.542E+03	1.525E+04	1.520E+04	3.884E+02	-3.696E+02	-1.290E+01
MAXIMUM	2.384E+04	3.027E+04	8.919E+03	7.385E+03	1.371E+04	8.991E+03	3.269E+04	3.341E+04	6.401E+02	5.045E+02	1.064E+02
ELEMENT	43	71	77	72	74	56	71	71	38	17	59
MINIMUM	-8.070E+03	-1.440E+04	-8.906E+03	-2.454E+04	-3.099E+04	-9.026E+03	1.011E+02	2.417E+02	3.477E+02	-4.703E+02	-1.175E+02
ELEMENT	72	74	56	64	71	77	9	16	72	59	17

BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES
LOAD CASE 3 FIVE FOOT DROP 48 G

RPLTSTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
1	3.862E+02	3.727E+02	1.078E+00	4.011E+02	3.813E+02	-9.218E-01	3.863E+02	4.012E+02	3.937E+02	3.770E+02	7.822E-02
2	3.926E+02	3.881E+02	2.799E+00	3.955E+02	3.638E+02	-2.847E+00	3.940E+02	3.957E+02	3.941E+02	3.760E+02	-2.440E-02
3	4.122E+02	4.741E+02	-2.765E+00	3.488E+02	2.708E+02	1.122E+01	4.743E+02	3.504E+02	3.823E+02	3.725E+02	4.226E+00
4	4.090E+02	3.790E+02	2.628E+00	3.779E+02	3.782E+02	-3.420E+00	4.092E+02	3.815E+02	3.934E+02	3.786E+02	-3.962E-01
5	4.146E+02	3.999E+02	-3.477E+00	3.718E+02	3.568E+02	1.667E+00	4.154E+02	3.720E+02	3.933E+02	3.784E+02	-9.050E-01
6	3.567E+02	3.421E+02	2.665E+00	4.296E+02	4.208E+02	-3.407E+00	3.572E+02	4.307E+02	3.931E+02	3.814E+02	-3.710E-01
7	3.682E+02	4.915E+02	1.354E+01	3.900E+02	2.743E+02	-9.432E+00	4.930E+02	3.908E+02	3.838E+02	3.829E+02	2.053E+00
8	4.998E+02	4.114E+02	-4.090E+00	2.858E+02	3.473E+02	1.152E+01	4.900E+02	3.493E+02	3.892E+02	3.793E+02	3.715E+00
9	5.049E+02	3.764E+02	8.637E+00	2.966E+02	3.874E+02	-1.211E+01	5.055E+02	3.890E+02	4.009E+02	3.819E+02	-1.735E+00
10	3.940E+02	3.773E+02	1.851E+00	3.921E+02	3.760E+02	-7.357E-01	3.942E+02	3.921E+02	3.931E+02	3.767E+02	5.578E-01
11	3.931E+02	3.856E+02	2.417E-03	3.943E+02	3.657E+02	3.307E+00	3.931E+02	3.947E+02	3.939E+02	3.757E+02	1.655E+00
12	4.073E+02	3.801E+02	-3.018E+00	3.759E+02	3.746E+02	4.852E+00	4.076E+02	3.801E+02	3.917E+02	3.774E+02	9.171E-01
13	4.121E+02	3.955E+02	3.781E+00	3.724E+02	3.586E+02	1.532E+00	4.129E+02	3.725E+02	3.927E+02	3.770E+02	2.656E+00
14	4.136E+02	4.737E+02	2.621E+00	3.502E+02	2.706E+02	-1.145E+01	4.738E+02	3.518E+02	3.836E+02	3.721E+02	-4.413E+00
15	3.592E+02	3.405E+02	-1.323E+00	4.296E+02	4.171E+02	5.426E+00	3.593E+02	4.316E+02	3.947E+02	3.788E+02	2.051E+00
16	3.736E+02	4.905E+02	-1.553E+01	3.956E+02	2.740E+02	7.325E+00	4.925E+02	3.961E+02	3.877E+02	3.822E+02	-4.101E+00
17	4.709E+02	3.858E+02	4.475E+00	2.998E+02	3.380E+02	-1.606E+01	4.711E+02	3.439E+02	3.867E+02	3.619E+02	-5.793E+00
18	5.070E+02	3.704E+02	-1.330E+01	3.010E+02	3.739E+02	8.532E+00	5.083E+02	3.749E+02	4.042E+02	3.722E+02	-2.384E+00
19	3.987E+04	3.826E+04	3.478E+02	-3.961E+04	-3.896E+04	-3.453E+02	3.903E+04	3.976E+04	3.711E+02	-3.530E+02	1.283E+00
20	3.691E+04	3.638E+04	6.930E+02	-3.766E+04	-3.708E+04	-6.854E+02	3.739E+04	3.811E+04	3.722E+02	-3.518E+02	3.793E+00
21	1.641E+04	5.512E+03	1.900E+03	-1.712E+04	-6.205E+03	-1.898E+03	1.673E+04	1.744E+04	3.569E+02	-3.464E+02	1.166E+00
22	3.509E+04	3.520E+04	1.149E+03	-3.582E+04	-3.591E+04	-1.145E+03	3.629E+04	3.701E+04	3.682E+02	-3.529E+02	1.764E+00
23	3.214E+04	3.426E+04	2.933E+03	-3.288E+04	-3.497E+04	-2.923E+03	3.632E+04	3.703E+04	3.702E+02	-3.526E+02	4.951E+00
24	1.561E+04	1.722E+04	5.319E+03	-1.635E+04	-1.793E+04	-5.304E+03	2.180E+04	2.250E+04	3.716E+02	-3.535E+02	7.404E+00
25	8.934E+03	3.052E+03	5.067E+03	-9.656E+03	-3.763E+03	-5.061E+03	1.185E+04	1.257E+04	3.619E+02	-3.552E+02	2.864E+00
26	7.089E+03	1.596E+04	1.765E+03	-7.800E+03	-1.664E+04	-1.771E+03	1.630E+04	1.698E+04	3.560E+02	-3.365E+02	-2.695E+00
27	7.398E+03	1.295E+04	5.310E+03	-8.146E+03	-1.364E+04	-5.306E+03	1.617E+04	1.687E+04	3.741E+02	-3.450E+02	2.382E+00
28	3.887E+04	3.826E+04	-3.435E+02	-3.962E+04	-3.897E+04	3.448E+02	3.903E+04	3.977E+04	3.729E+02	-3.544E+02	6.671E-01
29	3.691E+04	3.638E+04	-6.808E+02	-3.766E+04	-3.709E+04	6.843E+02	3.738E+04	3.812E+04	3.735E+02	-3.532E+02	1.763E+00
30	3.509E+04	3.521E+04	-1.145E+03	-3.584E+04	-3.593E+04	1.145E+03	3.630E+04	3.703E+04	3.739E+02	-3.573E+02	3.810E-01
31	3.215E+04	3.427E+04	-2.921E+03	-3.290E+04	-3.499E+04	2.923E+03	3.632E+04	3.705E+04	3.734E+02	-3.575E+02	6.929E-01
32	1.641E+04	5.507E+03	-1.881E+03	-1.712E+04	-6.207E+03	1.901E+03	1.672E+04	1.744E+04	3.645E+02	-3.499E+02	1.033E+01
33	1.563E+04	1.722E+04	-5.300E+03	-1.638E+04	-1.795E+04	5.307E+03	2.178E+04	2.253E+04	3.755E+02	-3.639E+02	3.318E+00
34	8.944E+03	3.035E+03	-5.050E+03	-9.662E+03	-3.768E+03	5.065E+03	1.184E+04	1.258E+04	3.712E+02	-3.664E+02	7.653E+00
35	7.153E+03	1.598E+04	-1.769E+03	-7.904E+03	-1.670E+04	1.780E+03	1.632E+04	1.705E+04	3.771E+02	-3.611E+02	5.369E+00
36	7.438E+03	1.295E+04	-5.310E+03	-8.202E+03	-1.368E+04	5.327E+03	1.618E+04	1.693E+04	3.859E+02	-3.660E+02	8.338E+00
37	-1.880E+04	-2.028E+03	-1.290E+02	-9.749E+03	8.590E+02	-1.410E+02	1.880E+04	1.061E+04	1.428E+04	-5.846E+02	-1.350E+02
38	-1.899E+04	-1.545E+03	1.525E+01	-1.047E+04	4.670E+02	5.711E+01	1.899E+04	1.093E+04	1.473E+04	-5.391E+02	3.618E+01
39	-1.928E+04	-2.120E+03	9.481E+01	-9.936E+03	1.333E+03	2.421E+02	1.928E+04	1.128E+04	1.461E+04	-3.935E+02	1.684E+02
40	-1.858E+04	-1.808E+03	1.932E+02	-9.868E+03	7.543E+02	1.500E+02	1.858E+04	1.063E+04	1.423E+04	-5.267E+02	1.716E+02
41	-1.829E+04	-2.107E+03	1.107E+02	-9.469E+03	1.026E+03	-9.386E+01	1.829E+04	1.050E+04	1.388E+04	-5.406E+02	8.445E+00
42	-1.816E+04	-1.644E+03	-1.007E+02	-9.982E+03	4.898E+02	-1.366E+02	1.816E+04	1.048E+04	1.407E+04	-5.769E+02	-1.186E+02
43	-1.861E+04	-1.899E+03	9.257E+00	-9.888E+03	7.851E+02	4.962E+01	1.861E+04	1.067E+04	1.425E+04	-5.567E+02	2.944E+01
44	-1.861E+04	-1.900E+03	1.877E+00	-9.887E+03	7.837E+02	-3.641E+01	1.861E+04	1.067E+04	1.425E+04	-5.583E+02	-1.727E+01
45	-1.816E+04	-1.650E+03	1.132E+02	-9.976E+03	4.851E+02	1.511E+02	1.816E+04	1.047E+04	1.407E+04	-5.824E+02	1.322E+02
46	-1.828E+04	-2.125E+03	-9.319E+01	-9.445E+03	1.026E+03	1.120E+02	1.828E+04	1.047E+04	1.386E+04	-5.500E+02	9.418E+00
47	-1.856E+04	-1.839E+03	-1.695E+02	-9.823E+03	7.440E+02	-1.383E+02	1.856E+04	1.057E+04	1.419E+04	-5.476E+02	-1.539E+02
48	-1.928E+04	-2.173E+03	-7.997E+01	-9.910E+03	1.301E+03	-2.672E+02	1.928E+04	1.122E+04	1.460E+04	-4.358E+02	-1.736E+02
49	-1.917E+04	-1.617E+03	-6.132E+01	-1.065E+04	4.244E+02	-1.271E+02	1.917E+04	1.107E+04	1.491E+04	-5.963E+02	-9.423E+01
50	-1.924E+04	-2.040E+03	8.306E+01	-1.025E+04	7.738E+02	8.966E+01	1.925E+04	1.102E+04	1.475E+04	-6.330E+02	8.636E+01
51	9.673E+03	6.311E+03	-3.325E+02	-3.796E+04	-7.858E+03	-3.163E+02	9.706E+03	3.796E+04	1.415E+04	-7.735E+02	-3.244E+02

BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES
LOAD CASE 3 FIVE FOOT DROP 48 G

RPLISTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
52	8.856E+03	6.347E+03	7.835E+01	-3.854E+04	-7.867E+03	1.330E+02	8.859E+03	3.854E+04	1.484E+04	-7.600E+02	1.057E+02
53	9.371E+03	6.421E+03	-1.133E+02	-3.872E+04	-8.228E+03	3.192E+02	9.375E+03	3.872E+04	1.467E+04	-9.036E+02	1.029E+02
54	9.255E+03	6.257E+03	1.848E+02	-3.754E+04	-7.815E+03	4.211E+02	9.266E+03	3.755E+04	1.415E+04	-7.790E+02	3.029E+02
55	9.506E+03	6.174E+03	-4.188E+00	-3.670E+04	-7.855E+03	8.259E+01	9.506E+03	3.670E+04	1.360E+04	-8.402E+02	3.920E+01
56	8.393E+03	5.915E+03	-1.628E+02	-3.654E+04	-7.431E+03	-2.435E+02	8.403E+03	3.654E+04	1.408E+04	-7.582E+02	-2.032E+02
57	8.781E+03	6.099E+03	1.929E+02	-3.725E+04	-7.709E+03	4.885E+01	8.795E+03	3.726E+04	1.424E+04	-8.049E+02	1.209E+02
58	8.780E+03	6.098E+03	-1.821E+02	-3.725E+04	-7.710E+03	-3.260E+01	8.792E+03	3.725E+04	1.424E+04	-8.059E+02	-1.073E+02
59	8.392E+03	5.913E+03	1.741E+02	-3.654E+04	-7.430E+03	2.605E+02	8.404E+03	3.654E+04	1.408E+04	-7.587E+02	2.173E+02
60	9.515E+03	6.176E+03	1.915E+01	-3.669E+04	-7.855E+03	-5.875E+01	9.515E+03	3.669E+04	1.359E+04	-8.397E+02	-1.980E+01
61	9.294E+03	6.265E+03	-1.553E+02	-3.752E+04	-7.821E+03	-3.887E+02	9.302E+03	3.752E+04	1.412E+04	-7.782E+02	-2.720E+02
62	9.420E+03	6.399E+03	1.198E+02	-3.866E+04	-8.221E+03	-2.849E+02	9.424E+03	3.867E+04	1.462E+04	-9.113E+02	-8.256E+01
63	8.641E+03	6.250E+03	-1.559E+02	-3.861E+04	-7.841E+03	-1.567E+02	8.651E+03	3.861E+04	1.499E+04	-7.953E+02	-1.563E+02
64	9.010E+03	6.255E+03	2.450E+02	-3.834E+04	-7.929E+03	2.711E+02	9.032E+03	3.834E+04	1.467E+04	-8.370E+02	2.580E+02
79	5.560E+03	8.657E+03	6.450E+01	2.719E+03	-3.486E+02	6.620E+01	8.658E+03	3.071E+03	4.213E+03	4.154E+03	6.535E+01
80	5.434E+03	8.159E+03	1.519E+02	3.734E+03	-2.143E+02	1.146E+02	8.168E+03	3.955E+03	4.612E+03	3.973E+03	1.332E+02
81	5.715E+03	8.572E+03	1.960E+02	1.613E+03	-8.974E+02	2.510E+02	8.585E+03	2.561E+03	3.990E+03	3.837E+03	2.235E+02
82	5.479E+03	8.284E+03	5.309E+01	2.731E+03	-4.854E+02	1.502E+02	8.285E+03	3.230E+03	4.147E+03	3.899E+03	1.016E+02
83	5.259E+03	8.110E+03	-7.596E+01	2.329E+03	-6.204E+02	-1.333E+02	8.112E+03	2.961E+03	3.877E+03	3.745E+03	-1.047E+02
84	5.321E+03	7.914E+03	-1.051E+02	3.347E+03	-1.830E+02	-1.068E+02	7.919E+03	3.536E+03	4.357E+03	3.866E+03	-1.060E+02
85	5.382E+03	8.400E+03	-9.722E+01	2.655E+03	-3.358E+02	-7.217E+01	8.404E+03	2.994E+03	4.110E+03	4.032E+03	-8.470E+01
86	5.384E+03	8.402E+03	1.032E+02	2.657E+03	-3.328E+02	7.609E+01	8.405E+03	2.993E+03	4.117E+03	4.035E+03	8.965E+01
87	5.327E+03	7.915E+03	1.117E+02	3.354E+03	-1.778E+02	1.113E+02	7.920E+03	3.539E+03	4.366E+03	3.868E+03	1.115E+02
88	5.270E+03	8.090E+03	8.878E+01	2.358E+03	-6.224E+02	1.439E+02	8.093E+03	2.994E+03	3.897E+03	3.734E+03	1.163E+02
89	5.521E+03	8.248E+03	-4.883E+01	2.797E+03	-4.970E+02	-1.375E+02	8.249E+03	3.306E+03	4.187E+03	3.875E+03	-9.315E+01
90	5.804E+03	8.585E+03	-2.361E+02	1.713E+03	-8.671E+02	-2.537E+02	8.605E+03	2.630E+03	4.059E+03	3.859E+03	-2.449E+02
91	5.492E+03	8.422E+03	-2.327E+02	3.822E+03	4.952E+01	-1.723E+02	8.440E+03	3.829E+03	4.738E+03	4.236E+03	-2.025E+02
92	5.613E+03	8.262E+03	-1.228E+02	2.700E+03	1.988E+02	-1.184E+02	9.266E+03	2.705E+03	4.755E+03	4.730E+03	-1.206E+02
93	-3.014E+03	-1.934E+04	3.023E+02	1.114E+04	2.800E+04	2.737E+02	1.935E+04	2.801E+04	4.514E+03	4.329E+03	2.880E+02
94	-3.451E+03	-1.977E+04	-7.516E+01	1.094E+04	2.751E+04	7.162E+00	1.977E+04	2.751E+04	3.879E+03	3.870E+03	-3.400E+01
95	-2.860E+03	-1.970E+04	-2.134E+02	1.10EE+04	2.807E+04	3.710E+02	1.970E+04	2.808E+04	4.233E+03	4.183E+03	7.859E+01
96	-3.187E+03	-1.972E+04	1.432E+02	1.071E+04	2.697E+04	2.890E+02	1.972E+04	2.698E+04	3.920E+03	3.626E+03	2.161E+02
97	-3.029E+03	-1.929E+04	-1.955E+02	1.102E+04	2.688E+04	-2.250E+02	1.929E+04	2.688E+04	4.129E+03	3.796E+03	-2.102E+02
98	-3.071E+03	-1.864E+04	8.527E+01	1.040E+04	2.628E+04	-2.352E+01	1.864E+04	2.628E+04	3.629E+03	3.823E+03	3.087E+01
99	-3.005E+03	-1.883E+04	-1.875E+02	1.076E+04	2.719E+04	-3.291E+02	1.883E+04	2.720E+04	4.331E+03	4.183E+03	-2.583E+02
100	-3.003E+03	-1.883E+04	1.976E+02	1.076E+04	2.720E+04	3.339E+02	1.883E+04	2.720E+04	4.339E+03	4.185E+03	2.657E+02
101	-3.068E+03	-1.864E+04	-7.529E+01	1.041E+04	2.629E+04	2.801E+01	1.864E+04	2.629E+04	3.831E+03	3.828E+03	-2.364E+01
102	-3.026E+03	-1.929E+04	2.172E+02	1.103E+04	2.688E+04	2.413E+02	1.929E+04	2.688E+04	4.150E+03	3.797E+03	2.293E+02
103	-3.173E+03	-1.974E+04	-9.875E+01	1.071E+04	2.694E+04	-2.424E+02	1.974E+04	2.695E+04	3.876E+03	3.599E+03	-1.706E+02
104	-2.801E+03	-1.974E+04	2.529E+02	1.116E+04	2.804E+04	-3.575E+02	1.974E+04	2.804E+04	4.218E+03	4.149E+03	-5.229E+01
105	-3.416E+03	-1.963E+04	1.714E+00	1.110E+04	2.780E+04	-1.368E+02	1.963E+04	2.780E+04	4.103E+03	4.085E+03	-6.755E+01
106	-3.022E+03	-1.884E+04	-3.970E+02	1.112E+04	2.879E+04	-4.106E+02	1.885E+04	2.880E+04	5.127E+03	4.976E+03	-4.038E+02
107	1.265E+03	1.413E+04	1.123E+02	-9.091E+03	-2.078E+04	2.825E+02	1.413E+04	2.079E+04	3.973E+03	-3.327E+03	1.974E+02
108	1.801E+03	1.506E+04	-2.849E+02	-9.738E+03	-2.102E+04	-1.992E+02	1.507E+04	2.102E+04	4.024E+03	-2.977E+03	-2.420E+02
109	1.144E+03	1.474E+04	-3.173E+02	-8.607E+03	-2.124E+04	-5.646E+01	1.475E+04	2.124E+04	3.795E+03	-3.250E+03	-1.869E+02
110	1.446E+03	1.482E+04	6.510E+01	-8.976E+03	-2.069E+04	9.385E+01	1.482E+04	2.069E+04	3.773E+03	-2.938E+03	7.948E+01
111	1.523E+03	1.451E+04	-1.052E+02	-8.740E+03	-2.034E+04	-6.867E+01	1.451E+04	2.034E+04	3.619E+03	-2.917E+03	-8.694E+01
112	1.482E+03	1.421E+04	1.584E+02	-9.164E+03	-2.015E+04	1.440E+02	1.421E+04	2.015E+04	3.867E+03	-2.971E+03	1.512E+02
113	1.416E+03	1.419E+04	-1.579E+02	-8.964E+03	-2.062E+04	-2.763E+02	1.419E+04	2.062E+04	3.848E+03	-3.214E+03	-2.171E+02
114	1.416E+03	1.419E+04	1.587E+02	-8.960E+03	-2.062E+04	2.771E+02	1.419E+04	2.062E+04	3.847E+03	-3.214E+03	2.179E+02
115	1.488E+03	1.421E+04	-1.650E+02	-9.162E+03	-2.015E+04	-1.473E+02	1.421E+04	2.015E+04	3.864E+03	-2.969E+03	-1.562E+02
116	1.542E+03	1.453E+04	8.268E+01	-8.764E+03	-2.035E+04	7.604E+01	1.453E+04	2.035E+04	3.620E+03	-2.910E+03	7.936E+01

MAX. SECONDARY BENDING SI SHELL
28.80 - 5.13 = 23.67 Ksi

BOTTOM END PLUG 5 FOOT DROP STRESS INTENSITIES
LOAD CASE 3 FIVE FOOT DROP 48 G

RPLTSTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
117	1.447E+03	1.490E+04	-7.669E+01	-9.040E+03	-2.074E+04	-4.198E+01	1.490E+04	2.074E+04	3.801E+03	-2.922E+03	-5.934E+01
118	1.051E+03	1.477E+04	4.054E+02	-8.637E+03	-2.144E+04	2.003E+02	1.478E+04	2.144E+04	3.944E+03	-3.337E+03	3.029E+02
119	1.912E+03	1.531E+04	2.281E+02	-9.514E+03	-2.116E+04	1.158E+02	1.531E+04	2.116E+04	3.834E+03	-2.926E+03	1.720E+02
120	1.505E+03	1.575E+04	-5.406E+02	-9.260E+03	-1.958E+04	-7.970E+02	1.577E+04	1.964E+04	4.084E+03	-1.914E+03	-6.688E+02
MAXIMUM	3.887E+04	3.826E+04	5.319E+03	1.116E+04	2.879E+04	5.327E+03	3.903E+04	3.977E+04	1.499E+04	4.976E+03	3.029E+02
ELEMENT	28	28	24	104	106	36	19	28	63	106	54
MINIMUM	-1.928E+04	-1.977E+04	-5.310E+03	-3.962E+04	-3.897E+04	-5.306E+03	3.572E+02	3.439E+02	3.560E+02	-3.337E+03	-6.688E+02
ELEMENT	39	94	36	28	28	27	6	17	26	118	120

ENCL 5

ATTACHMENT 12

STARDYNE Inputs and Outputs
for the Spacer Disk 5 Foot
Drop Analysis

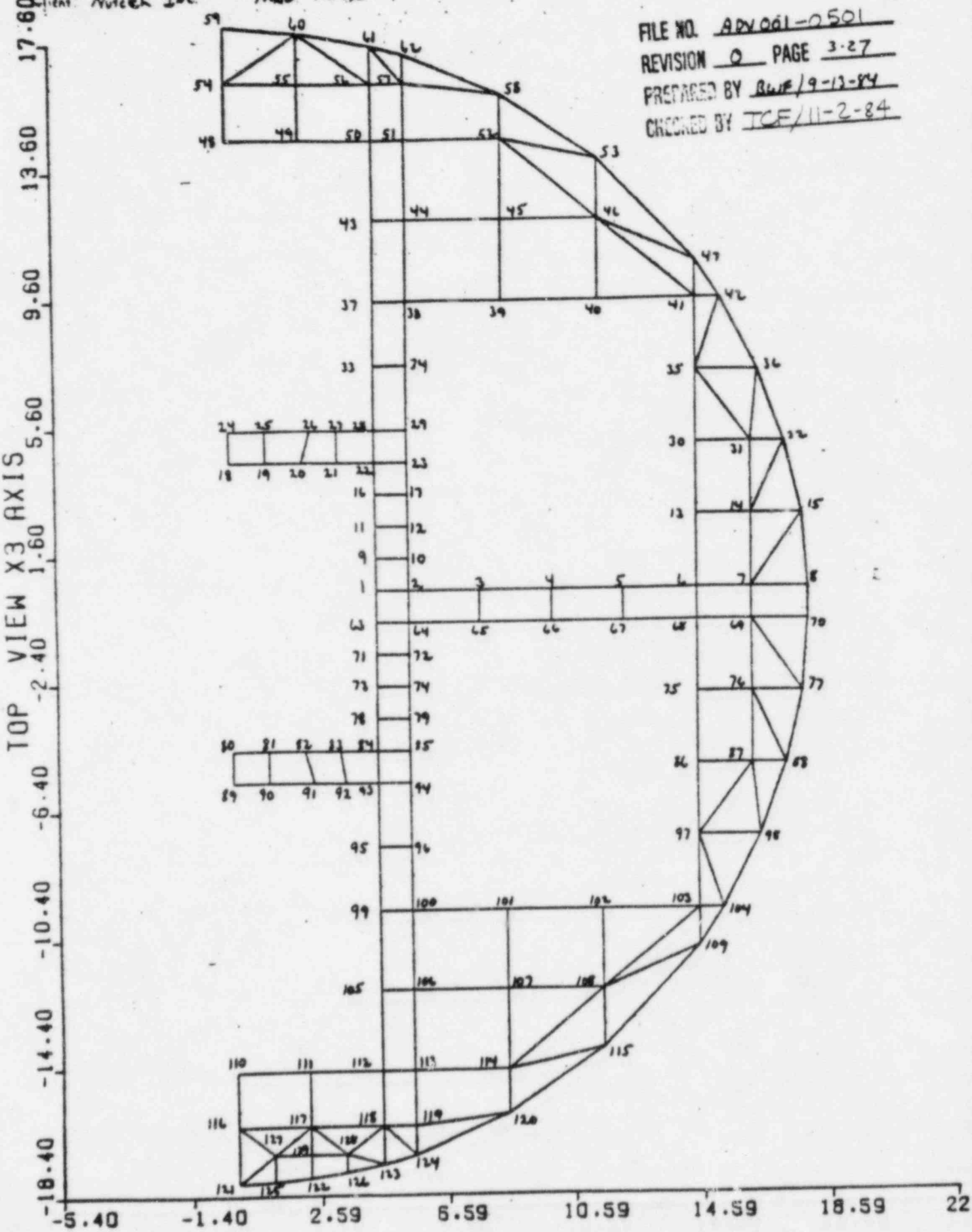


Figure 3.1
Spacer Disk Model - Node Numbers

FILE NO. ADV001
REVISION 0 PAGE 3-28
PREPARED BY BWF/9-13-84
CHECKED BY TCF/11-2-84

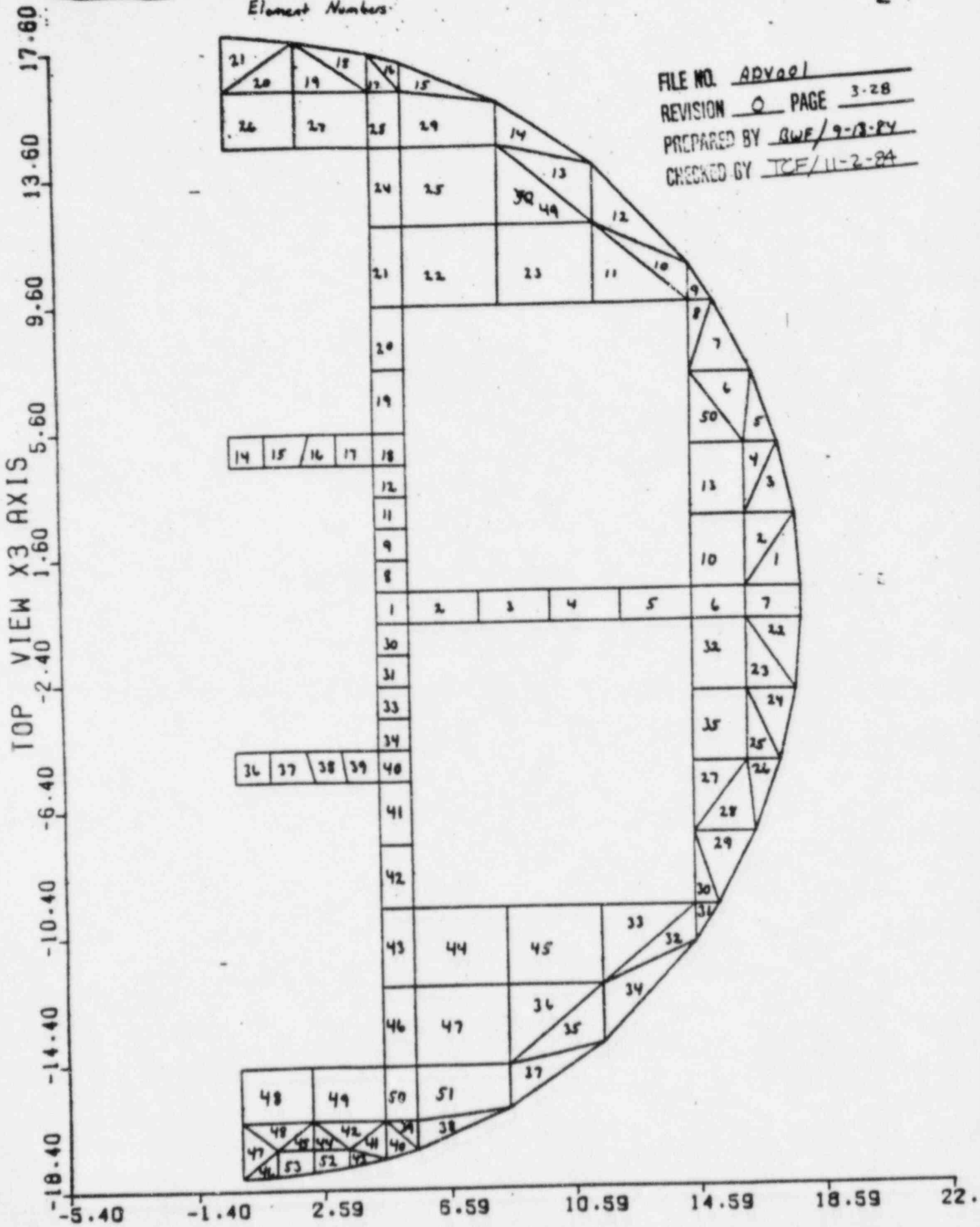


Figure 3-2
Spacer Disk Model - Element Numbers

CARD IMAGE

```
1  4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80
*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
```

CARD NO							CARD TYPE
2	PLOTS	1	1	SC240	72		PLOTS
3	SPACER DISKS						SPAC
4	MATER	1	55304	26.5E6	0.30	0.2834 8.97E-6	MATER
5	END						END
6	NODE	1	4.50	.50	0.0000		NODE
7	NODE	2	5.50	.50	0.0000		NODE
8	NODE	3	7.75	.50	0.0000		NODE
9	NODE	4	10.00	.50	0.0000		NODE
10	NODE	5	12.25	.50	0.0000		NODE
11	NODE	6	14.50	.50	0.0000		NODE
12	NODE	7	16.25	.50	0.0000		NODE
13	NODE	8	17.69	.50	0.0000		NODE
14	NODE	9	4.50	1.50	0.0000		NODE
15	NODE	10	5.50	1.50	0.0000		NODE
16	NODE	11	4.5000	2.5000	0.0000		NODE
17	NODE	12	5.50	2.5000	0.0000		NODE
18	NODE	13	14.50	2.7500	0.0000		NODE
19	NODE	14	16.25	2.7500	0.0000		NODE
20	NODE	15	17.7500	2.7500	0.0000		NODE
21	NODE	16	4.5000	3.5000	0.0000		NODE
22	NODE	17	5.50	3.5000	0.0000		NODE
23	NODE	18	0.0000	4.50	0.0000		NODE
24	NODE	19	1.1250	4.50	0.0000		NODE
25	NODE	20	2.2500	4.5000	0.0000		NODE
26	NODE	21	3.3750	4.5000	0.0000		NODE
27	NODE	22	4.5000	4.5000	0.0000		NODE
28	NODE	23	5.50	4.5000	0.0000		NODE
29	NODE	24	0.0000	5.50	0.0000		NODE
30	NODE	25	1.1250	5.50	0.0000		NODE
31	NODE	26	2.2500	5.50	0.0000		NODE
32	NODE	27	3.3750	5.50	0.0000		NODE
33	NODE	28	4.5000	5.50	0.0000		NODE
34	NODE	29	5.50	5.50	0.0000		NODE
35	NODE	30	14.50	5.0000	0.0000		NODE
36	NODE	31	16.25	5.0000	0.0000		NODE
37	NODE	32	17.2500	5.0000	0.0000		NODE
38	NODE	33	4.5000	7.5000	0.0000		NODE
39	NODE	34	5.50	7.5000	0.0000		NODE
40	NODE	35	14.50	7.25	0.0000		NODE
41	NODE	36	16.4750	7.25	0.0000		NODE
42	NODE	37	4.5000	9.5000	0.0000		NODE
43	NODE	38	5.50	9.5000	0.0000		NODE
44	NODE	39	8.5000	9.5000	0.0000		NODE
45	NODE	40	11.5000	9.5000	0.0000		NODE
46	NODE	41	14.50	9.5000	0.0000		NODE
47	NODE	42	15.2840	9.5000	0.0000		NODE
48	NODE	43	4.5000	12.0000	0.0000		NODE
49	NODE	44	5.50	12.0000	0.0000		NODE
50	NODE	45	8.5000	12.0000	0.0000		NODE
51	NODE	46	11.5000	12.0000	0.0000		NODE
52	NODE	47	14.50	10.6600	0.0000		NODE
53	NODE	48	0.0000	14.50	0.0000		NODE
54	NODE	49	2.2500	14.50	0.0000		NODE

CARD INPUT

CARD NO						CARD TYPE
55	NODE	50	4.5000	14.50	0.0000	NODE
56	NODE	51	5.50	14.50	0.0000	NODE
57	NODE	52	8.5000	14.50	0.0000	NODE
58	NODE	53	11.5000	13.8500	0.0000	NODE
59	NODE	54	0.0000	16.2500	0.0000	NODE
60	NODE	55	2.2500	16.2500	0.0000	NODE
61	NODE	56	4.5000	16.2500	0.0000	NODE
62	NODE	57	5.50	16.2500	0.0000	NODE
63	NODE	58	8.5000	15.6600	0.0000	NODE
64	NODE	59	0.0000	18.0000	0.0000	NODE
65	NODE	60	2.2500	17.8200	0.0000	NODE
66	NODE	61	4.5000	17.4200	0.0000	NODE
67	NODE	62	5.50	17.1400	0.0000	NODE
68	NODE	63	4.50	- .50	0.0000	NODE
69	NODE	64	5.50	- .50	0.0000	NODE
70	NODE	65	7.75	- .50	0.0000	NODE
71	NODE	66	10.00	- .50	0.0000	NODE
72	NODE	67	12.25	- .50	0.0000	NODE
73	NODE	68	14.50	- .50	0.0000	NODE
74	NODE	69	16.25	- .50	0.0000	NODE
75	NODE	70	17.99	- .50	0.0000	NODE
76	NODE	71	4.50	- 1.50	0.0000	NODE
77	NODE	72	5.50	- 1.50	0.0000	NODE
78	NODE	73	4.5000	-2.5000	0.0000	NODE
79	NODE	74	5.50	-2.5000	0.0000	NODE
80	NODE	75	14.50	-2.7500	0.0000	NODE
81	NODE	76	16.25	-2.7500	0.0000	NODE
82	NODE	77	17.7800	-2.7500	0.0000	NODE
83	NODE	78	4.5000	-3.5000	0.0000	NODE
84	NODE	79	5.50	-3.5000	0.0000	NODE
85	NODE	80	0.0000	- 4.50	0.0000	NODE
86	NODE	81	1.1250	- 4.50	0.0000	NODE
87	NODE	82	2.2500	-4.5000	0.0000	NODE
88	NODE	83	3.3750	-4.5000	0.0000	NODE
89	NODE	84	4.5000	-4.5000	0.0000	NODE
90	NODE	85	5.50	-4.5000	0.0000	NODE
91	NODE	86	14.50	-5.0000	0.0000	NODE
92	NODE	87	16.25	-5.0000	0.0000	NODE
93	NODE	88	17.2900	-5.0000	0.0000	NODE
94	NODE	89	0.0000	- 5.50	0.0000	NODE
95	NODE	90	1.1250	- 5.50	0.0000	NODE
96	NODE	91	2.2500	- 5.50	0.0000	NODE
97	NODE	92	3.3750	- 5.50	0.0000	NODE
98	NODE	93	4.5000	- 5.50	0.0000	NODE
99	NODE	94	5.50	- 5.50	0.0000	NODE
100	NODE	95	4.5000	-7.5000	0.0000	NODE
101	NODE	96	5.50	-7.5000	0.0000	NODE
102	NODE	97	14.50	-7.25	0.0000	NODE
103	NODE	98	16.4750	-7.25	0.0000	NODE
104	NODE	99	4.5000	-9.5000	0.0000	NODE
105	NODE	100	5.50	-9.5000	0.0000	NODE
106	NODE	101	8.5000	-9.5000	0.0000	NODE
107	NODE	102	11.5000	-9.5000	0.0000	NODE
108	NODE	103	14.50	-9.5000	0.0000	NODE

*** STARDYNE 3.0 INPUT ***

CARD IMAGE

CARD NO						CARD TYPE
109	NODE	104	13.2500	-5.5000	0.0000	NODE
110	NODE	105	9.5000	-13.0000	0.0000	NODE
111	NODE	106	5.50	-12.0000	0.0000	NODE
112	NODE	107	9.5000	-12.0000	0.0000	NODE
113	NODE	108	11.5000	-12.0000	0.0000	NODE
114	NODE	109	14.50	-10.5000	0.0000	NODE
115	NODE	110	0.0000	- 14.50	0.0000	NODE
116	NODE	111	2.2500	- 14.50	0.0000	NODE
117	NODE	112	4.5000	- 14.50	0.0000	NODE
118	NODE	113	5.50	- 14.50	0.0000	NODE
119	NODE	114	8.5000	- 14.50	0.0000	NODE
120	NODE	115	11.5000	-13.0500	0.0000	NODE
121	NODE	116	0.0000	-16.250	0.000	NODE
122	NODE	117	2.2500	-16.250	0.000	NODE
123	NODE	118	4.5000	-16.250	0.000	NODE
124	NODE	119	5.50	-16.250	0.000	NODE
125	NODE	120	8.5000	-15.500	0.000	NODE
126	NODE	121	0.0000	-14.000	0.000	NODE
127	NODE	122	2.2500	-17.820	0.000	NODE
128	NODE	123	4.5000	-17.420	0.000	NODE
129	NODE	124	5.50	-17.140	0.000	NODE
130	NODE	125	1.1250	-17.9844	0.0000	NODE
131	NODE	126	3.3750	-17.6887	0.000	NODE
132	NODE	127	1.1250	-17.133	0.000	NODE
133	NODE	128	3.3750	-17.146	0.000	NODE
134	NODE	129	2.2500	-17.125	0.000	NODE
135	END					END
136	RESTR	40	100011			RESTR
137	RESTR	59	100011			RESTR
138	RESTR	54	100011			RESTR
139	RESTR	48	100011			RESTR
140	RESTR	34	100011			RESTR
141	RESTR	18	100011			RESTR
142	RESTR	42	100011			RESTR
143	RESTR	110	100011			RESTR
144	RESTR	116	100011			RESTR
145	RESTR	121	110011			RESTR
146	RESTR	125	011000			RESTR
147	RESTR	122	010000			RESTR
148	RESTR	126	010000			RESTR
149	RESTR	123	010020			RESTR
150	END					END
151	WGHT	80		17.70		WGHT
152	WGHT	94		17.70		WGHT
153	WGHT	81		35.40		WGHT
154	WGHT	82		35.40		WGHT
155	WGHT	83		35.40		WGHT
156	WGHT	110		35.40		WGHT
157	WGHT	111		70.80		WGHT
158	WGHT	112		35.40		WGHT
159	WGHT	24		17.70		WGHT
160	WGHT	25		35.40		WGHT
161	WGHT	26		35.40		WGHT
162	WGHT	27		35.40		WGHT

```
                                   *** STARDYNE 3.0      INPUT ***
                  /---------------------------------- CARD IMAGE ----------------------------------/
                  1  4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80
                  *  *   *  *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
CARD NO
    163  WGHT      28              17.70                                                          WGHT
    164  WGHT       2              35.40                                                          WGHT
    165  WGHT       3              70.80                                                          WGHT
    166  WGHT       4              70.80                                                          WGHT
    167  WGHT       5              70.80                                                          WGHT
    168  WGHT       6              35.40                                                          WGHT
    169  WGHT     100              47.20                                                          WGHT
    170  WGHT     103              47.20                                                          WGHT
    171  WGHT     101              94.40                                                          WGHT
    172  WGHT     102              94.40                                                          WGHT
    173  END                                                                                     END
    174  TRIAB      1       8      15       7        1  1    1.25                                TRIAB
    175  TRIAB      2       7      15      14        1  1    1.25                                TRIAB
    176  TRIAB      3      15      32      14        1  1    1.25                                TRIAB
    177  TRIAB      4      14      32      31        1  1    1.25                                TRIAB
    178  TRIAB      5      32      38      31        1  1    1.25                                TRIAB
    179  TRIAB      6      31      38      35        1  1    1.25                                TRIAB
    180  TRIAB      7      35      42      35        1  1    1.25                                TRIAB
    181  TRIAB      8      35      42      41        1  1    1.25                                TRIAB
    182  TRIAB      9      42      47      41        1  1    1.25                                TRIAB
    183  TRIAB     10      41      47      46        1  1    1.25                                TRIAB
    184  TRIAB     11      41      46      40        1  1    1.25                                TRIAB
    185  TRIAB     12      47      53      46        1  1    1.25                                TRIAB
    186  TRIAB     13      46      53      52        1  1    1.25                                TRIAB
    187  TRIAB     14      53      58      52        1  1    1.25                                TRIAB
    188  TRIAB     15      53      62      57        1  1    1.25                                TRIAB
    189  TRIAB     16      57      62      61        1  1    1.25                                TRIAB
    190  TRIAB     17      57      61      56        1  1    1.25                                TRIAB
    191  TRIAB     18      56      61      60        1  1    1.25                                TRIAB
    192  TRIAB     19      56      60      55        1  1    1.25                                TRIAB
    193  TRIAB     20      55      66      64        1  1    1.25                                TRIAB
    194  TRIAB     21      64      68      69        1  1    1.25                                TRIAB
    195  TRIAB     22      70      69      77        1  1    1.25                                TRIAB
    196  TRIAB     23      69      76      77        1  1    1.25                                TRIAB
    197  TRIAB     24      77      75      [illegible]  1  1    1.25                                TRIAB
    198  TRIAB     25      76      87      86        1  1    1.25                                TRIAB
    199  TRIAB     26      88      87      88        1  1    1.25                                TRIAB
    200  TRIAB     27      87      96      97        1  1    1.25                                TRIAB
    201  TRIAB     28      87      97      98        1  1    1.25                                TRIAB
    202  TRIAB     29      98      97     109        1  1    1.25                                TRIAB
    203  TRIAB     30      97     103     109        1  1    1.25                                TRIAB
    204  TRIAB     31     109     103     109        1  1    1.25                                TRIAB
    205  TRIAB     32     105     109     109        1  1    1.25                                TRIAB
    206  TRIAB     33     103     102     105        1  1    1.25                                TRIAB
    207  TRIAB     34     109     108     113        1  1    1.25                                TRIAB
    208  TRIAB     35     109     113     113        1  1    1.25                                TRIAB
    209  TRIAB     36     108     107     113        1  1    1.25                                TRIAB
    210  TRIAB     37     115     113     120        1  1    1.25                                TRIAB
    211  TRIAB     38     120     119     124        1  1    1.25                                TRIAB
    212  TRIAB     39     119     118     124        1  1    1.25                                TRIAB
    213  TRIAB     40     118     123     124        1  1    1.25                                TRIAB
    214  TRIAB     41     123     118     128        1  1    1.25                                TRIAB
    215  TRIAB     42     118     117     128        1  1    1.25                                TRIAB
    216  TRIAB     43     123     125     126        1  1    1.25                                TRIAB
```

*** STARTING LOC = 4F0E4 ***

CARD INPUT

CARD NO	1	5	9	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	CARD TYPE
217	TRIAB			44		128		117		124			1	1	1.25							TRIAB
218	TRIAB			49		48		52		45			1	1	1.25							TRIAB
219	TRIAB			50		31		35		30			1	1	1.25							TRIAB
220	TRIAB			45		129		117		127			1	1	1.25							TRIAB
221	TRIAB			46		125		127		121			1	1	1.25							TRIAB
222	TRIAB			47		121		127		116			1	1	1.25							TRIAB
223	TRIAB			48		117		116		127			1	1	1.25							TRIAB
224	END																					END
225	QUADB			1		54		2		1			53		1	1	1.25					QUADB
226	QUADB			2		65		3		2			64		1	1	1.25					QUADB
227	QUADB			3		66		4		3			65		1	1	1.25					QUADB
228	QUADB			4		67		5		4			66		1	1	1.25					QUADB
229	QUADB			5		68		6		5			67		1	1	1.25					QUADB
230	QUADB			6		69		7		6			68		1	1	1.25					QUADB
231	QUADB			7		70		8		7			69		1	1	1.25					QUADB
232	QUADB			8		2		10		9			1		1	1	1.25					QUADB
233	QUADB			9		10		12		11			9		1	1	1.25					QUADB
234	QUADB			10		7		14		13			6		1	1	1.25					QUADB
235	QUADB			11		12		17		16			11		1	1	1.25					QUADB
236	QUADB			12		17		23		22			16		1	1	1.25					QUADB
237	QUADB			13		14		31		30			13		1	1	1.25					QUADB
238	QUADB			14		19		25		24			18		1	1	1.25					QUADB
239	QUADB			15		20		26		25			19		1	1	1.25					QUADB
240	QUADB			16		21		27		26			20		1	1	1.25					QUADB
241	QUADB			17		22		28		27			21		1	1	1.25					QUADB
242	QUADB			18		23		29		28			22		1	1	1.25					QUADB
243	QUADB			19		24		34		33			28		1	1	1.25					QUADB
244	QUADB			20		34		38		37			33		1	1	1.25					QUADB
245	QUADB			21		35		44		43			37		1	1	1.25					QUADB
246	QUADB			22		39		45		44			38		1	1	1.25					QUADB
247	QUADB			23		40		46		45			39		1	1	1.25					QUADB
248	QUADB			24		44		51		50			43		1	1	1.25					QUADB
249	QUADB			25		45		52		51			44		1	1	1.25					QUADB
250	QUADB			26		49		55		54			48		1	1	1.25					QUADB
251	QUADB			27		50		56		55			49		1	1	1.25					QUADB
252	QUADB			28		51		57		56			50		1	1	1.25					QUADB
253	QUADB			29		52		58		57			51		1	1	1.25					QUADB
254	QUADB			30		72		54		53			71		1	1	1.25					QUADB
255	QUADB			31		74		72		71			73		1	1	1.25					QUADB
256	QUADB			32		76		64		63			75		1	1	1.25					QUADB
257	QUADB			33		74		74		73			74		1	1	1.25					QUADB
258	QUADB			34		95		79		78			94		1	1	1.25					QUADB
259	QUADB			35		87		76		75			86		1	1	1.25					QUADB
260	QUADB			36		90		81		80			89		1	1	1.25					QUADB
261	QUADB			37		91		82		81			90		1	1	1.25					QUADB
262	QUADB			38		92		83		82			91		1	1	1.25					QUADB
263	QUADB			39		93		84		83			92		1	1	1.25					QUADB
264	QUADB			40		94		85		84			93		1	1	1.25					QUADB
265	QUADB			41		96		94		93			95		1	1	1.25					QUADB
266	QUADB			42		100		96		95			99		1	1	1.25					QUADB
267	QUADB			43		105		100		99			101		1	1	1.25					QUADB
268	QUADB			44		107		101		100			106		1	1	1.25					QUADB
269	QUADB			45		108		102		101			107		1	1	1.25					QUADB
270	QUADB			46		113		106		105			112		1	1	1.25					QUADB

*** STARDYNE 3.0 INPUT ***

CARD IMAGE

```
                1   4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80
                +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +
CARD NO         ********************************************************************************  CARD TYPE
    271 QUAD3       47      114     107     106     113       1   1   1.25                          QUADB
    272 QUAD4       48      117     111     110     116       1   1   1.25                          QUADB
    273 QUAD5       49      118     112     111     117       1   1   1.25                          QUADB
    274 QUAD6       50      119     113     112     118       1   1   1.25                          QUADB
    275 QUAD7       51      120     114     113     119       1   1   1.25                          QUADB
    276 QUAD8       52      126     128     129     122       1   1   1.25                          QUADB
    277 QUAD9       53      122     129     127     125       1   1   1.25                          QUADB
    278 END                                                                                       END
    279 ENDGEOM                                                                                   ENDGE
    280  STATIC ANALYSIS 5 DEGREE-FIVE FOOT DROP                                                   STAT
    281 STATIC                                                                                    STATI
    282  LOAD CASE 2                                                                              LOAD
    283 ACCEL      -1                  34.6                                                       ACCEL
    284 END                                                                                       END
    285 END CASE                                                                                  END C
    286 ALL DONE                                                                                  ALL D
    287 OPTION                                                                                    OPTIO
    288 OUTPUT          1       2       2       2                                                 OUTPU
    289 TAPE46          1                                       1   11                            TAPE4
    290 ENDMODEL                                                                                  ENDMO
```

TRS,LFN=AS(AP(...,OP=RW,L=DISK249S,CT=PU,PW=ADV,SY=**.

84/09/13 18.08.34

```
*****************************************
*                                       *
*        T R S    T A P E    I N F O    *
*                                       *
*                  A013724              *
*                                       *
*  SYM          : AJMIWXX    VSN      : AQ2HBZ  *
*  FN           :     1      RN       :     1   *
*  APW          :            WPW      : ADV     *
*  DATE READ    :            NO R     :     0   *
*  DATE WRIT    :            NO W     :     0   *
*  DATE CERT    :            NO C     :     0   *
*  DATE ACQ     : 84/09/13   CT       : PU      *
*  PP           :            PO       :         *
*  F            :            FA       :         *
*  TR           :            D        :         *
*  LB           :            CV       :         *
*  ALTVSN       :            WPO      :         *
*  W            : W          FLAGS    : L/O/N   *
*  L            : DISK249S                      *
*  COM          :                               *
*                                       *
*****************************************
```

```
AJM1.MI. 04/10/84. C P T I C O M  CYBER  SERVICES.          NOS 1.4 552/552.

20.35.42.RWF,PF,1750.
20.35.42.USER,AJM1C7A.
20.35.42.CHARGE,12345JI,0000.
20.35.42.ROUTE,OUTPUT,LC=PR,DF,F10=RWF27.
20.35.42. ROUTE COMPLETE.
20.35.42.RFL,175000,R,UPR,STM&AJM1VRT.
20.35.45.ATTACH(OF,PUBF,L=$DISK2493          (,VSN=AL2587)
20.36.36.M130, ASSIGNED TO OF      , VSN=AL2587.
20.36.36.SKIPFR,F1,2,4.
20.36.36.COPYBR,OF,TAPE4.
20.36.37. COPY COMPLETE.
20.36.37.REWIND,TAPE4.
20.36.37.GET,APPLIC/UN=LIBRARY.
20.36.38.BEGIN,POST4,APPLIC.
20.36.40.$BEGIN,L960,APPLIC,INPUT,POST4,$1.2.0$.
20.36.42.RETURN,L960,GABLK2.
20.36.43.ATTACH,L960/UN=LIBRARY,M=R,PW=.
20.36.43.L960.      POST4,1.2.0
20.36.43.       END  L960
20.36.43.     020600 MAXIMUM EXECUTION FL.
20.36.43.       0.146 CP SECONDS EXECUTION TIME.
20.36.44.RETURN,L960.
20.36.44.ATTACH,GABLK2/UN=LIBRARY,M=R,PW=.
20.36.44.GABLK2.      POST4,1.2.0
20.36.45.     STOP
20.36.45.     022300 MAXIMUM EXECUTION FL.
20.36.45.       0.150 CP SECONDS EXECUTION TIME.
20.36.45.RETURN,GABLK2.
20.36.45.REVERT.
20.36.45.$RETURN,OLA.
20.36.45.$ATTACH,OLA=OLA4/UN=LIBRARY,M=R,PW=.
20.36.45.$REWIND,OLA.
20.36.45.$REVERT.     POST4 ATTACHED (LFN=OLA)
20.36.46.OLA,PL=5500.
20.36.47. START APPLICATION  EPI2
20.36.47. * * *   P O S T 4   * * *
20.36.47. *      VERSION  1.2       *
20.36.47. * *     LEVEL 07JAN82     *
20.36.52. * *  E N D  P O S T 4  * *
20.36.52.     STOP
20.36.52.     114700   FINAL EXECUTION FL.
20.36.52.       2.137 CP SECONDS EXECUTION TIME.
20.36.52. APPLEVEL NORMAL TERMINATION.
20.36.52. JOB RERECEIVED.
20.36.52.       1.381 SRUS USED BY APPLICATION
20.36.52. RPV - PREVIOUS ERROR CONDITIONS RESET.
20.36.52.RETURN,OF.
20.36.53.GOTO,1.
20.36.53.1.DAYFILE,DAY.
20.36.53. USER DAYFILE PROCESSED.
20.36.53.REPLACE,DAY.
20.36.53.UCLP,       C.003KUNS.
20.36.53.UCPF,       0.182KUNS.
20.36.53.UCMI,       0.065KUNS.
20.36.53.UCMS,       8.967KUNS.
20.36.53.UCCP,       3.318SECS.
20.36.53.ACSR,       6.421UNTS.
20.39.23.UCLP, AA2C,      0.917KLNS.
```

20

```
                              * * *  POST4      1.2        INPUT  * * *

                                                 CARD IMAGE
          /---------1---------2---------3---------4---------5---------6---------7---------8
          1    5    10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
          *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *
CARD NO   ********************************************************************************

      1   TITLE      SPACECRAFT DISK STRESS INTENSITY EVALUATION 5 FOOT DROP
      2   SEL-VECTORSG    1    1    1
      3   SEL-TPLTSTSG    1   48    1
      4   SEL-RPLTSTSG    1   53    1
      5   LIST       1    1    1    2    3    4    5    6   10   11   12
      6   WRITE7C
```

```
POST1 *** SPACE3D DISK STRESS INTENSITY EVALUATION & ROOT ERROR                    ***

SCALE FACTOR =  .1000E+01
FLAG TO PRINT TAPE 20 = 1


SELECTED LIST OPTIONS =     1    2    3    4    5    6   10   11   12    8    9


OPTION =  1      SXP     NORMAL STRESS - LOCAL X - + FACE
       =  2      SYP     NORMAL STRESS - LOCAL Y - + FACE
       =  3     SXYP     SHEAR STRESS - LOCAL XY - + FACE
       =  4      SXN     NORMAL STRESS - LOCAL X - - FACE
       =  5      SYN     NORMAL STRESS - LOCAL Y - - FACE
       =  6     SXYN     SHEAR STRESS - LOCAL XY - - FACE
       =  7      SXM     MEMBRANE NORMAL STRESS - LOCAL X
       =  8      SYM     MEMBRANE NORMAL STRESS - LOCAL Y
       =  9     SXYM     MEMBRANE SHEAR STRESS - LOCAL XY
       = 10      SIP     STRESS INTENSITY - + FACE
       = 11      SIN     STRESS INTENSITY - - FACE
       = 12      SIM     MEMBRANE STRESS INTENSITY
       = 13      S1P     MAXIMUM PRINCIPAL STRESS - + FACE
       = 14      S2P     MINIMUM PRINCIPAL STRESS - + FACE
       = 15      S3P     PRINCIPAL STRESS DIFF. - + FACE
       = 16      S1N     MAXIMUM PRINCIPAL STRESS - - FACE
       = 17      S2N     MINIMUM PRINCIPAL STRESS - - FACE
       = 18      S3N     PRINCIPAL STRESS DIFF. - FACE
       = 19      S1M     MAXIMUM MEMBRANE STRESS
       = 20      S2M     MINIMUM MEMBRANE STRESS
       = 21      S3M     MEMBRANE PRINCIPAL STRESS DIFF.
       = 22    S12MAXP   MAX. ABS. PRINCIPAL STRESS - + FACE
       = 23    S12MAXN   MAX. ABS. PRINCIPAL STRESS - - FACE
       = 24    S12MAXM   MAX. ABS. MEMBRANE STRESS
       = 25    S1MAXEF   MAX. OF MAX. STRESS INTEN. - E.F.
       = 26    S1MAXEF   MAX. OF MAX. PRIN. STRESSES - E.F.
       = 27    S1MINEF   MIN. OF MAX. PRIN. STRESSES - E.F.
       = 28    S2MAXEF   MAX. OF MIN. PRIN. STRESSES - E.F.
       = 29    S2MINEF   MIN. OF MIN. PRIN. STRESSES - E.F.
       = 30   S1ABMAXEF  MAX. OF ABS. MAX. PRINCIPAL STRESSES
       = 31   S2ABMAXEF  MAX. OF ABS. MIN. PRINCIPAL STRESSES
       = 32     THETAM   AXIS ANGLE OF PRIN. MEMB. STRESSES
       = 33      SXB     BENDING STRESS - LOCAL X
       = 34      SYB     BENDING STRESS - LOCAL Y
       = 35      SXZ     TRANSVERSE SHEAR XZ
       = 36      SYZ     TRANSVERSE SHEAR YZ


FLAG TO PRINT VECTORS =     1
OUTPUT FORMAT FOR LIST OPTION =     1
          FORMAT 1 = (1X,I4,5X,1P,11(E10.3,1X))
          FORMAT 2 = (1X,I4,5X,11(F10.0,1X))
          FORMAT 3 = (1X,I4,5X,11(F10.4,1X))
```

SPACER DISK STRESS INTENSITY EVALUATION 5 FOOT DROP
LOAD CASE 2

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
1	-1.695E+03	3.611E+02	4.412E+02	-1.695E+03	3.611E+02	4.412E+02	2.237E+03	2.237E+03	2.237E+03	3.611E+02	4.412E+02
2	-9.530E+02	1.099E+03	-2.011E+02	-9.530E+02	1.099E+03	-2.011E+02	2.091E+03	2.091E+03	2.091E+03	1.099E+03	-2.011E+02
3	-2.730E+03	4.323E+02	-5.192E+02	-2.730E+03	4.323E+02	-5.192E+02	3.328E+03	3.328E+03	3.328E+03	4.323E+02	-5.192E+02
4	-6.339E+02	2.696E+02	3.029E+02	-6.339E+02	2.696E+02	3.029E+02	1.088E+03	1.088E+03	1.088E+03	2.696E+02	3.029E+02
5	-2.517E+03	7.364E+02	-1.259E+03	-2.517E+03	7.364E+02	-1.259E+03	4.114E+03	4.114E+03	4.114E+03	7.364E+02	-1.259E+03
6	-4.606E+02	7.009E+02	1.285E+03	-4.606E+02	7.009E+02	1.285E+03	2.820E+03	2.820E+03	2.820E+03	7.009E+02	1.285E+03
7	-1.780E+03	1.962E+03	-8.813E+02	-1.780E+03	1.962E+03	-8.813E+02	4.137E+03	4.137E+03	4.137E+03	1.962E+03	-8.813E+02
8	2.495E+03	3.696E+03	6.669E+03	2.495E+03	3.696E+03	6.669E+03	1.339E+04	1.339E+04	1.339E+04	3.696E+03	6.669E+03
9	-1.042E+04	9.199E+03	-5.703E+03	-1.042E+04	9.199E+03	-5.703E+03	2.270E+04	2.270E+04	2.270E+04	9.199E+03	-5.703E+03
10	1.341E+03	-1.468E+03	1.599E+03	1.341E+03	-1.468E+03	1.599E+03	4.256E+03	4.256E+03	4.256E+03	-1.468E+03	1.599E+03
11	1.593E+03	-2.589E+02	1.542E+02	1.593E+03	-2.589E+02	1.542E+02	1.877E+03	1.877E+03	1.877E+03	-2.589E+02	1.542E+02
12	5.806E+02	-4.399E+02	-2.489E+02	5.806E+02	-4.399E+02	-2.489E+02	1.135E+03	1.135E+03	1.135E+03	-4.399E+02	-2.489E+02
13	6.763E+02	8.777E+02	5.220E+02	6.763E+02	8.777E+02	5.220E+02	1.309E+03	1.309E+03	1.309E+03	8.777E+02	5.220E+02
14	1.750E+03	3.273E+02	-5.135E+02	1.750E+03	3.273E+02	-5.135E+02	1.916E+03	1.916E+03	1.916E+03	3.273E+02	-5.135E+02
15	4.968E+03	-2.286E+03	-1.649E+03	4.968E+03	-2.286E+03	-1.649E+03	7.969E+03	7.969E+03	7.969E+03	-2.286E+03	-1.649E+03
16	1.979E+03	9.186E+03	5.066E+02	1.979E+03	9.186E+03	5.066E+02	9.222E+03	9.222E+03	9.222E+03	9.186E+03	5.066E+02
17	2.949E+03	-2.932E+03	1.888E+03	2.949E+03	-2.932E+03	1.888E+03	6.990E+03	6.990E+03	6.990E+03	-2.932E+03	1.888E+03
18	2.484E+02	6.907E+03	-2.361E+02	2.484E+02	6.907E+03	-2.361E+02	6.915E+03	6.915E+03	6.915E+03	6.907E+03	-2.361E+02
19	3.521E+02	-6.273E+02	2.665E+01	3.521E+03	-6.273E+02	2.665E+01	4.149E+03	4.149E+03	4.149E+03	-6.273E+02	2.665E+01
20	1.601E+02	3.675E+02	-1.315E+03	1.601E+02	3.675E+02	-1.315E+03	2.638E+03	2.638E+03	2.638E+03	3.675E+02	-1.315E+03
21	2.504E+03	2.226E+03	-3.202E+03	2.504E+03	2.226E+03	-3.202E+03	6.410E+03	6.410E+03	6.410E+03	2.226E+03	-3.202E+03
22	-2.869E+02	6.738E+02	-5.792E+02	-2.869E+02	6.738E+02	-5.792E+02	1.506E+03	1.506E+03	1.506E+03	6.738E+02	-5.792E+02
23	2.894E+02	-5.538E+02	7.908E+02	2.894E+02	-5.538E+02	7.908E+02	1.792E+03	1.792E+03	1.792E+03	-5.538E+02	7.908E+02
24	-1.299E+02	1.702E+03	5.103E+02	-1.299E+02	1.702E+03	5.103E+02	2.097E+03	2.097E+03	2.097E+03	1.702E+03	5.103E+02
25	2.815E+02	-1.070E+02	5.980E+02	2.815E+02	-1.070E+02	5.980E+02	1.257E+03	1.257E+03	1.257E+03	-1.070E+02	5.980E+02
26	2.957E+02	1.624E+03	1.583E+03	2.957E+02	1.624E+03	1.583E+03	3.433E+03	3.433E+03	3.433E+03	1.624E+03	1.583E+03
27	7.913E-01	-3.452E+03	-1.596E+02	7.913E-01	-3.452E+03	-1.596E+02	3.468E+03	3.468E+03	3.468E+03	-3.452E+03	-1.596E+02
28	-1.585E+03	1.255E+03	1.015E+03	-1.585E+03	1.255E+03	1.015E+03	3.490E+03	3.490E+03	3.490E+03	1.255E+03	1.015E+03
29	-5.159E+02	1.412E+03	2.229E+03	-5.159E+02	1.412E+03	2.229E+03	4.857E+03	4.857E+03	4.857E+03	1.412E+03	2.229E+03
30	-7.976E+03	6.655E+02	7.918E+03	-7.976E+03	6.655E+02	7.918E+03	1.804E+04	1.804E+04	1.804E+04	6.655E+02	7.918E+03
31	2.504E+03	-1.847E+03	1.774E+04	2.504E+03	-1.847E+03	1.774E+04	3.575E+04	3.575E+04	3.575E+04	-1.847E+03	1.774E+04
32	-1.716E+03	2.379E+03	-2.589E+03	-1.716E+03	2.379E+03	-2.589E+03	6.601E+03	6.601E+03	6.601E+03	2.379E+03	-2.589E+03
33	-2.017E+03	-9.777E+02	-9.849E+02	-2.017E+03	-9.777E+02	-9.849E+02	2.611E+03	2.611E+03	2.611E+03	-9.777E+02	-9.849E+02
34	-2.548E+02	8.647E+01	-4.745E+02	-2.548E+02	8.647E+01	-4.745E+02	1.009E+03	1.009E+03	1.009E+03	8.647E+01	-4.745E+02
35	-1.986E+03	3.317E+02	-4.919E+01	-1.986E+03	3.317E+02	-4.919E+01	2.320E+03	2.320E+03	2.320E+03	3.317E+02	-4.919E+01
36	-7.610E+00	-9.075E+02	-1.463E+03	-7.610E+00	-9.075E+02	-1.463E+03	3.062E+03	3.062E+03	3.062E+03	-9.075E+02	-1.463E+03
37	-1.664E+03	-9.219E+02	5.304E+02	-1.664E+03	-9.219E+02	5.304E+02	1.940E+03	1.940E+03	1.940E+03	-9.219E+02	5.304E+02
38	-6.149E+03	-4.027E+03	-6.579E+03	-6.149E+03	-4.027E+03	-6.579E+03	1.334E+04	1.334E+04	1.334E+04	-4.027E+03	-6.579E+03
39	-1.500E+03	-4.851E+03	-6.463E+03	-1.500E+03	-4.851E+03	-6.463E+03	1.335E+04	1.335E+04	1.335E+04	-4.851E+03	-6.463E+03
40	-2.260E+04	-2.105E+04	1.668E+04	-2.260E+04	-2.105E+04	1.668E+04	3.852E+04	3.852E+04	3.852E+04	-2.105E+04	1.668E+04
41	-2.101E+04	-1.572E+04	-9.772E+03	-2.101E+04	-1.572E+04	-9.772E+03	2.849E+04	2.849E+04	2.849E+04	-1.572E+04	-9.772E+03
42	-4.994E+03	-7.524E+03	3.397E+03	-4.994E+03	-7.524E+03	3.397E+03	9.884E+03	9.884E+03	9.884E+03	-7.524E+03	3.397E+03
43	-1.813E+04	-6.981E+03	-3.666E+03	-1.813E+04	-6.981E+03	-3.666E+03	1.922E+04	1.922E+04	1.922E+04	-6.981E+03	-3.666E+03
44	-8.250E+03	5.166E+01	-5.384E+03	-8.250E+03	5.166E+01	-5.384E+03	1.360E+04	1.360E+04	1.360E+04	5.166E+01	-5.384E+03
45	3.543E+03	-5.624E+03	-3.557E+03	3.543E+03	-5.624E+03	-3.557E+03	1.160E+04	1.160E+04	1.160E+04	-5.624E+03	-3.557E+03
46	4.790E+03	-4.284E+03	-2.812E+02	4.790E+03	-4.284E+03	-2.812E+02	9.092E+03	9.092E+03	9.092E+03	-4.284E+03	-2.812E+02
47	-8.621E+02	1.944E+02	3.652E+03	-8.621E+02	1.944E+02	3.652E+03	7.381E+03	7.381E+03	7.381E+03	1.944E+02	3.652E+03
48	-8.155E+02	3.218E+03	1.660E+03	-8.155E+02	3.218E+03	1.660E+03	5.224E+03	5.224E+03	5.224E+03	3.218E+03	1.660E+03

SPACE FRAME STRESS INTENSITY EVALUATION 5 FOOT DROP
LOAD CASE 2

IPLTSTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIP	SYM	SXYP
MAXIMUM	9.566E+03	9.199E+03	1.774E+04	4.988E+03	9.199E+03	1.774E+04	3.852E+04	3.852E+04	3.852E+04	9.199E+03	1.774E+04
ELEMENT	15	9	31	15	9	31	40	40	40	9	31
MINIMUM	-2.260E+04	-2.105E+04	-9.772E+03	-2.260E+04	-2.105E+04	-9.772E+03	1.009E+03	1.009E+03	1.009E+03	-2.105E+04	-9.772E+03
ELEMENT	40	40	41	40	40	41	34	34	34	40	41

SPACER DISK STRESS INTENSITY EVALUATION - DROP
LOAD CASE 2

RPLIST5

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
1	-6.243E+03	3.246E+02	-4.909E+03	-6.243E+03	3.246E+02	-4.909E+03	1.306E+04	1.306E+04	1.306E+04	3.246E+02	-4.909E+03
2	-8.445E+02	7.357E+02	3.069E+03	-8.445E+02	7.357E+02	3.069E+03	6.353E+03	6.353E+03	6.253E+03	7.357E+02	3.069E+03
3	-2.814E+02	7.357E+02	1.122E+03	-2.814E+02	7.357E+02	1.122E+03	2.464E+03	2.464E+03	2.464E+03	7.357E+02	1.122E+03
4	-5.424E+02	7.357E+02	-8.256E+02	-5.424E+02	7.357E+02	-8.256E+02	2.088E+03	2.088E+03	2.088E+03	7.357E+02	-8.256E+02
5	-1.167E+02	7.357E+02	-2.773E+03	-1.167E+02	7.357E+02	-2.773E+03	5.611E+03	5.611E+03	5.611E+03	7.357E+02	-2.773E+03
6	3.093E+02	1.495E+02	1.304E+03	3.093E+02	1.495E+02	1.304E+03	2.613E+03	2.613E+03	1.495E+02	1.038E+02	1.304E+03
7	-4.232E+02	1.038E+02	9.615E+02	-4.232E+02	1.038E+02	9.615E+02	1.994E+03	1.994E+03	1.994E+03	2.038E+03	9.615E+02
8	-7.041E+03	2.038E+03	1.927E+02	-7.041E+03	2.038E+03	1.927E+02	9.137E+03	9.137E+03	9.137E+03	2.038E+03	1.927E+02
9	-7.081E+03	-6.448E+02	1.927E+02	-7.081E+03	-6.448E+02	1.927E+02	7.087E+03	7.087E+03	7.087E+03	-6.448E+02	1.927E+02
10	2.363E+03	1.263E+03	-3.990E+02	2.363E+03	1.263E+03	-3.990E+02	2.515E+03	2.515E+03	2.515E+03	1.263E+03	-3.990E+02
11	-7.072E+03	5.412E+02	1.927E+02	-7.072E+03	5.412E+02	1.927E+02	7.623E+03	7.623E+03	7.623E+03	5.412E+02	1.927E+02
12	-7.062E+03	-1.520E+03	1.927E+02	-7.062E+03	-1.520E+03	1.927E+02	7.069E+03	7.069E+03	7.069E+03	-1.520E+03	1.927E+02
13	2.446E+03	-2.603E+02	4.399E+02	2.446E+03	-2.603E+02	4.399E+02	2.847E+03	2.847E+03	2.847E+03	-2.603E+02	4.399E+02
14	-4.115E+02	1.359E+02	-4.869E+02	-4.115E+02	1.359E+02	-4.869E+02	1.117E+03	1.117E+03	1.117E+03	1.359E+02	-4.869E+02
15	-5.099E+02	1.359E+02	-1.461E+03	-5.099E+02	1.359E+02	-1.461E+03	2.992E+03	2.992E+03	2.992E+03	1.359E+02	-1.461E+03
16	-1.164E+03	1.359E+02	-2.434E+03	-1.164E+03	1.359E+02	-2.434E+03	4.875E+03	4.875E+03	4.875E+03	1.359E+02	-2.434E+03
17	-1.592E+03	1.359E+02	-3.408E+03	-1.592E+03	1.359E+02	-3.408E+03	7.032E+03	7.032E+03	7.032E+03	1.359E+02	-3.408E+03
18	-4.072E+03	-3.782E+02	3.840E+03	-4.072E+03	-3.782E+02	3.840E+03	8.521E+03	8.521E+03	8.521E+03	-3.782E+02	3.840E+03
19	-3.143E+03	1.112E+03	5.684E+01	-3.143E+03	1.112E+03	5.684E+01	4.256E+03	4.256E+03	4.256E+03	1.112E+03	5.684E+01
20	-3.124E+03	-6.918E+02	5.684E+01	-3.124E+03	-6.918E+02	5.684E+01	3.125E+03	3.125E+03	3.125E+03	-6.918E+02	5.684E+01
21	-3.414E+02	5.547E+02	-6.957E+02	-3.414E+02	5.547E+02	-6.957E+02	1.655E+03	1.655E+03	1.655E+03	5.547E+02	-6.957E+02
22	-1.127E+03	-5.241E+02	5.301E+01	-1.127E+03	-5.241E+02	5.301E+01	1.132E+03	1.132E+03	1.132E+03	-5.241E+02	5.301E+01
23	4.308E+02	-3.227E+02	1.670E+02	4.308E+02	-3.227E+02	1.670E+02	8.241E+02	8.241E+02	8.241E+02	-3.227E+02	1.670E+02
24	-3.360E+03	-1.644E+03	-1.202E+03	-3.360E+03	-1.644E+03	-1.202E+03	3.595E+03	3.995E+03	3.995E+03	-1.644E+03	-1.202E+03
25	1.894E+02	-6.684E+02	-4.295E+02	1.894E+02	-6.684E+02	-4.295E+02	1.214E+03	1.214E+03	1.214E+03	-6.684E+02	-4.295E+02
26	8.287E+01	-2.735E+03	8.140E+01	8.287E+01	-2.735E+03	8.140E+01	2.802E+03	2.802E+03	2.802E+03	-2.735E+03	8.140E+01
27	-1.101E+03	-3.151E+03	-8.522E+02	-1.101E+03	-3.151E+03	-8.522E+02	3.459E+03	3.459E+03	3.459E+03	-3.151E+03	-8.522E+02
28	-9.933E+02	-6.823E+02	7.830E+02	-9.933E+02	-6.823E+02	7.830E+02	1.636E+03	1.636E+03	1.636E+03	-6.823E+02	7.830E+02
29	5.861E+02	1.276E+03	1.323E+03	5.861E+02	1.276E+03	1.323E+03	2.735E+03	2.735E+03	2.735E+03	1.276E+03	1.323E+03
30	-1.115E+04	-1.984E+03	-5.430E+02	-1.115E+04	-1.984E+03	-5.430E+02	1.119E+04	1.119E+04	1.119E+04	-1.984E+03	-5.430E+02
31	-1.116E+04	6.352E+02	-5.430E+02	-1.116E+04	6.352E+02	-5.430E+02	1.185E+04	1.185E+04	1.185E+04	6.352E+02	-5.430E+02
32	-1.365E+03	-1.032E+03	-1.065E+02	-1.365E+03	-1.032E+03	-1.065E+02	1.396E+03	1.396E+03	1.396E+03	-1.032E+03	-1.065E+02
33	-1.117E+04	-5.566E+02	-5.430E+02	-1.117E+04	-5.566E+02	-5.430E+02	1.120E+04	1.120E+04	1.120E+04	-5.566E+02	-5.430E+02
34	-1.118E+04	1.591E+03	-5.430E+02	-1.118E+04	1.591E+03	-5.430E+02	1.282E+04	1.282E+04	1.282E+04	1.591E+03	-5.430E+02
35	-1.772E+03	2.280E+02	5.725E+02	-1.772E+03	2.280E+02	5.725E+02	2.304E+03	2.304E+03	2.304E+03	2.280E+02	5.725E+02
36	-4.260E+02	1.501E+03	-4.869E+02	-4.260E+02	1.501E+03	-4.869E+02	2.160E+03	2.160E+03	2.160E+03	1.501E+03	-4.869E+02
37	-4.276E+02	1.501E+03	-1.461E+03	-4.276E+02	1.501E+03	-1.461E+03	3.500E+03	3.500E+03	3.500E+03	1.501E+03	-1.461E+03
38	-4.294E+02	1.501E+03	-2.434E+03	-4.294E+02	1.501E+03	-2.434E+03	5.237E+03	5.237E+03	5.237E+03	1.501E+03	-2.434E+03
39	-4.226E+02	1.501E+03	-3.408E+03	-4.226E+02	1.501E+03	-3.408E+03	7.082E+03	7.082E+03	7.082E+03	1.501E+03	-3.408E+03
40	-1.314E+04	9.486E+02	3.800E+03	-1.314E+04	9.986E+02	3.800E+03	1.606E+04	1.606E+04	1.606E+04	9.986E+02	3.800E+03
41	-1.510E+04	-1.113E+03	9.576E+02	-1.510E+04	-1.113E+03	9.576E+02	1.517E+04	1.517E+04	1.517E+04	-1.113E+03	9.576E+02
42	-1.512E+04	1.120E+03	9.576E+02	-1.512E+04	1.120E+03	9.576E+02	1.635E+04	1.635E+04	1.635E+04	1.120E+03	9.576E+02
43	-1.360E+04	-7.894E+02	-2.979E+03	-1.360E+04	-7.894E+02	-2.979E+03	1.425E+04	1.425E+04	1.425E+04	-7.894E+02	-2.979E+03
44	-1.900E+03	1.623E+03	4.194E+02	-1.900E+03	1.623E+03	4.194E+02	3.622E+03	3.622E+03	3.622E+03	1.623E+03	4.194E+02
45	-7.065E+02	5.037E+02	1.241E+03	-7.065E+02	5.037E+02	1.241E+03	2.761E+03	2.761E+03	2.761E+03	5.037E+02	1.241E+03
46	-7.018E+03	3.013E+03	-1.183E+03	-7.018E+03	3.013E+03	-1.183E+03	1.031E+04	1.031E+04	1.031E+04	3.013E+03	-1.183E+03
47	-5.244E+03	-2.949E+02	-4.348E+02	-5.244E+03	-2.949E+02	-4.348E+02	5.282E+03	5.282E+03	5.282E+03	-2.949E+02	-4.348E+02
48	8.171E+02	2.693E+03	-2.159E+03	8.171E+02	2.693E+03	-2.159E+03	4.707E+03	4.707E+03	4.707E+03	2.693E+03	-2.159E+03
49	-3.617E+03	7.375E+03	-3.290E+03	-3.617E+03	7.375E+03	-3.290E+03	1.281E+04	1.281E+04	1.281E+04	7.375E+03	-3.290E+03
50	-8.717E+03	2.585E+03	6.103E+03	-8.717E+03	2.585E+03	6.103E+03	1.663E+04	1.663E+04	1.663E+04	2.585E+03	6.103E+03
51	-4.626E+03	-1.447E+03	3.603E+03	-4.626E+03	-1.447E+03	3.603E+03	7.876E+03	7.876E+03	7.876E+03	-1.447E+03	3.603E+03

RPLTSTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYP
52	-2.317E+01	-9.882E+03	3.515E+02	-2.317E+01	-9.882E+03	3.515E+02	9.895E+03	9.895E+03	9.895E+03	-9.882E+03	3.515E+02
53	3.925E+03	-6.136E+03	-3.029E+02	3.925E+03	-6.136E+03	-3.029E+02	1.008E+04	1.008E+04	1.008E+04	-6.136E+03	-3.029E+02
MAXIMUM	3.925E+03	7.375E+03	6.103E+03	3.925E+03	7.375E+03	6.103E+03	1.663E+04	1.663E+04	1.663E+04	7.375E+03	6.103E+03
ELEMENT	53	49	50	53	49	50	50	50	50	49	50
MINIMUM	-1.512E+04	-9.882E+03	-4.909E+03	-1.512E+04	-9.882E+03	-4.909E+03	8.241E+02	8.241E+02	8.241E+02	-9.882E+03	-4.909E+03
ELEMENT	42	52	1	42	52	1	23	23	23	52	1

ENCL 6

ATTACHMENT 13

STARDYNE Inputs and Outputs
for the Spacer Disk Dead
Weight Analysis

Project: NUHOMS GENERIC DESIGN
Owner: Nutech INC
Client: Nutech Inc. Node Numbers

FILE NO. ADV001-0501
REVISION 0 PAGE 3-27
PREPARED BY BWE/9-12-84
CHECKED BY JCE/11-2-84

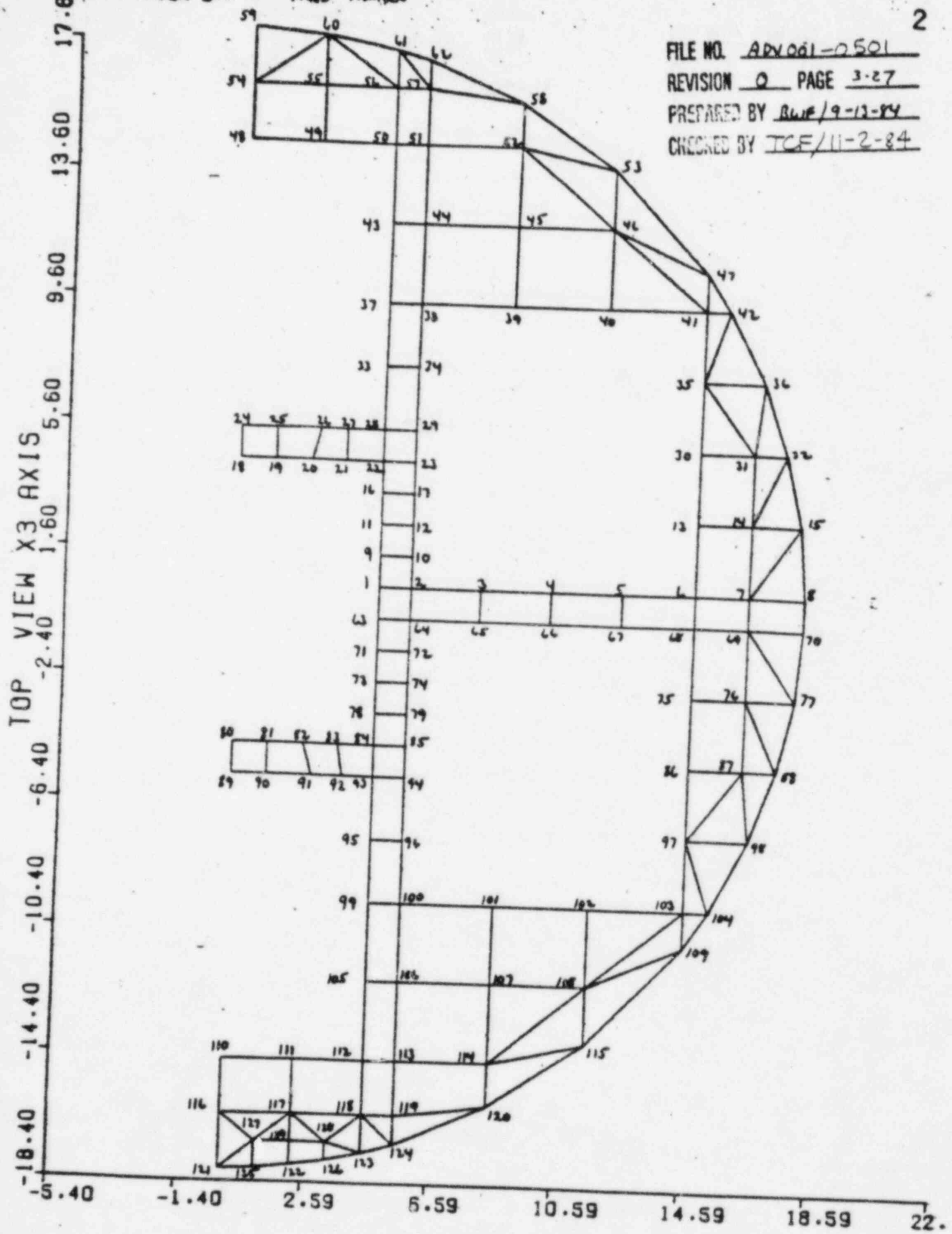


Figure 3.1
Spacer Disk Model - Node Numbers

FILE NO. ADV001
REVISION 0 PAGE 3-28
PREPARED BY BWE/9-13-84
CHECKED BY TCF/11-2-84

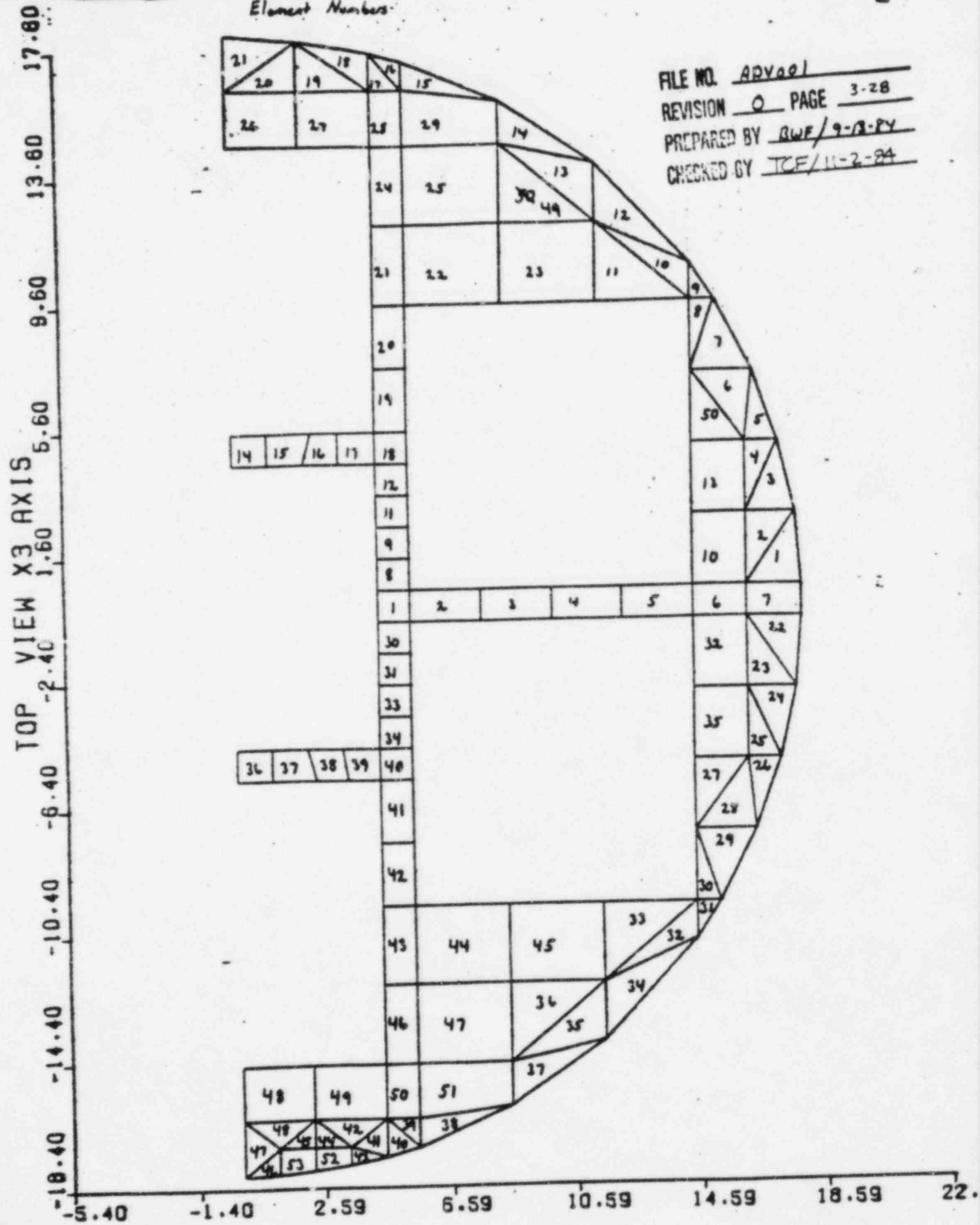


Figure 3-2
Spacer Disk Model - Element Numbers

*** STARDYNE 3.0 INPUT ***

CARD IMAGE

1 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80

CARD NO						CARD TYPE
1	**********					CARD
2	PLOTS	1	1	SC240	72	PLOTS
3	SPACER DISKS					SPAC
4	MATLG	1	SS304	28.016	0.30 0.2834 5.97E-6	MATLG
5	END					END
6	NODE	1	4.50	.50	0.0000	NODE
7	NODE	2	5.50	.50	0.0000	NODE
8	NODE	3	7.75	.50	0.0000	NODE
9	NODE	4	10.00	.50	0.0000	NODE
10	NODE	5	12.25	.50	0.0000	NODE
11	NODE	6	14.50	.50	0.0000	NODE
12	NODE	7	16.25	.50	0.0000	NODE
13	NODE	8	17.94	.50	0.0000	NODE
14	NODE	9	4.50	1.50	0.0000	NODE
15	NODE	10	5.50	1.50	0.0000	NODE
16	NODE	11	4.5000	2.5000	0.0000	NODE
17	NODE	12	5.50	2.5000	0.0000	NODE
18	NODE	13	14.50	2.7500	0.0000	NODE
19	NODE	14	16.25	2.7500	0.0000	NODE
20	NODE	15	17.7800	2.7500	0.0000	NODE
21	NODE	16	4.5000	3.5000	0.0000	NODE
22	NODE	17	5.50	3.5000	0.0000	NODE
23	NODE	18	0.0000	4.50	0.0000	NODE
24	NODE	19	1.1250	4.50	0.0000	NODE
25	NODE	20	2.2500	4.5000	0.0000	NODE
26	NODE	21	3.3750	4.5000	0.0000	NODE
27	NODE	22	4.5000	4.5000	0.0000	NODE
28	NODE	23	5.50	4.5000	0.0000	NODE
29	NODE	24	0.0000	5.50	0.0000	NODE
30	NODE	25	1.12500	5.50	0.0000	NODE
31	NODE	26	2.2500	5.50	0.0000	NODE
32	NODE	27	3.3750	5.50	0.0000	NODE
33	NODE	28	4.5000	5.50	0.0000	NODE
34	NODE	29	5.50	5.50	0.0000	NODE
35	NODE	30	14.50	5.0000	0.0000	NODE
36	NODE	31	16.25	5.0000	0.0000	NODE
37	NODE	32	17.2400	5.0000	0.0000	NODE
38	NODE	33	4.5000	7.5000	0.0000	NODE
39	NODE	34	5.50	7.5000	0.0000	NODE
40	NODE	35	14.50	7.25	0.0000	NODE
41	NODE	36	16.4750	7.25	0.0000	NODE
42	NODE	37	4.5000	9.5000	0.0000	NODE
43	NODE	38	5.50	9.5000	0.0000	NODE
44	NODE	39	8.5000	9.5000	0.0000	NODE
45	NODE	40	11.5000	9.5000	0.0000	NODE
46	NODE	41	14.50	9.5000	0.0000	NODE
47	NODE	42	15.2690	9.5000	0.0000	NODE
48	NODE	43	4.5000	12.5000	0.0000	NODE
49	NODE	44	5.50	12.0000	0.0000	NODE
50	NODE	45	8.5000	12.0000	0.0000	NODE
51	NODE	46	11.5000	12.0000	0.0000	NODE
52	NODE	47	14.50	10.6600	0.0000	NODE
53	NODE	48	0.0000	14.50	0.0000	NODE
54	NODE	49	2.2500	14.50	0.0000	NODE

*** STARDYNE 3.0 INPUT ***

CARD IMAGE

CARD NO							CARD TYPE
55	NODE	50	4.5000	14.50	0.0000		NODE
56	NODE	51	5.50	14.50	0.0000		NODE
57	NODE	52	8.5000	14.50	0.0000		NODE
58	NODE	53	11.5000	13.0500	0.0000		NODE
59	NODE	54	0.0000	16.2500	0.0000		NODE
60	NODE	55	2.2500	16.2500	0.0000		NODE
61	NODE	56	4.5000	16.2500	0.0000		NODE
62	NODE	57	5.50	16.2500	0.0000		NODE
63	NODE	58	8.5000	15.8000	0.0000		NODE
64	NODE	59	0.0000	18.0000	0.0000		NODE
65	NODE	60	2.2500	17.9250	0.0000		NODE
66	NODE	61	4.5000	17.9200	0.0000		NODE
67	NODE	62	5.50	17.1400	0.0000		NODE
68	NODE	63	4.50	- .50	0.0000		NODE
69	NODE	64	5.50	- .50	0.0000		NODE
70	NODE	65	7.75	- .50	0.0000		NODE
71	NODE	66	10.00	- .50	0.0000		NODE
72	NODE	67	12.25	- .50	0.0000		NODE
73	NODE	68	14.50	- .50	0.0000		NODE
74	NODE	69	16.25	- .50	0.0000		NODE
75	NODE	70	17.99	- .50	0.0000		NODE
76	NODE	71	4.50	- 1.50	0.0000		NODE
77	NODE	72	5.50	- 1.50	0.0000		NODE
78	NODE	73	4.5000	-2.5000	0.0000		NODE
79	NODE	74	5.50	-2.5000	0.0000		NODE
80	NODE	75	14.50	-2.7500	0.0000		NODE
81	NODE	76	16.25	-2.7500	0.0000		NODE
82	NODE	77	17.7600	-2.7500	0.0000		NODE
83	NODE	78	4.5000	-3.5000	0.0000		NODE
84	NODE	79	5.50	-3.5000	0.0000		NODE
85	NODE	80	0.0000	- 4.50	0.0000		NODE
86	NODE	81	1.1250	- 4.50	0.0000		NODE
87	NODE	82	2.2500	-4.5000	0.0000		NODE
88	NODE	83	3.3750	-4.5000	0.0000		NODE
89	NODE	84	4.5000	-4.5000	0.0000		NODE
90	NODE	85	5.50	-4.5000	0.0000		NODE
91	NODE	86	14.50	-5.5000	0.0000		NODE
92	NODE	87	16.25	-5.5000	0.0000		NODE
93	NODE	88	17.2900	-5.5000	0.0000		NODE
94	NODE	89	0.0000	- 5.50	0.0000		NODE
95	NODE	90	1.1250	- 5.50	0.0000		NODE
96	NODE	91	2.2500	- 5.50	0.0000		NODE
97	NODE	92	3.3750	- 5.50	0.0000		NODE
98	NODE	93	4.5000	- 5.50	0.0000		NODE
99	NODE	94	5.50	- 5.50	0.0000		NODE
100	NODE	95	4.5000	-7.5000	0.0000		NODE
101	NODE	96	5.50	-7.5000	0.0000		NODE
102	NODE	97	14.50	-7.25	0.0000		NODE
103	NODE	98	16.4750	-7.25	0.0000		NODE
104	NODE	99	4.5000	-9.5000	0.0000		NODE
105	NODE	100	5.50	-9.5000	0.0000		NODE
106	NODE	101	8.5000	-9.5000	0.0000		NODE
107	NODE	102	11.5000	-9.5000	0.0000		NODE
108	NODE	103	14.50	-9.5000	0.0000		NODE

CARD IMAGE

```
CARD NO  1   4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80
         *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
```

CARD NO						CARD TYPE
109	NODE	104	15.2890	-9.5000	0.0000	NODE
110	NODE	105	4.5000	-12.0000	0.0000	NODE
111	NODE	106	5.50	-12.0000	0.0000	NODE
112	NODE	107	8.5000	-12.0000	0.0000	NODE
113	NODE	108	11.5000	-12.0000	0.0000	NODE
114	NODE	109	14.50	-10.6600	0.0000	NODE
115	NODE	110	0.0000	- 14.50	0.0000	NODE
116	NODE	111	2.2500	- 14.50	0.0000	NODE
117	NODE	112	4.5000	- 14.50	0.0000	NODE
118	NODE	113	5.50	- 14.50	0.0000	NODE
119	NODE	114	8.5000	- 14.50	0.0000	NODE
120	NODE	115	11.5000	-13.8500	0.0000	NODE
121	NODE	116	0.0000	-16.250	0.000	NODE
122	NODE	117	2.2500	-16.250	0.000	NODE
123	NODE	118	4.5000	-16.250	0.000	NODE
124	NODE	119	5.50	-16.250	0.000	NODE
125	NODE	120	8.5000	-16.860	0.000	NODE
126	NODE	121	0.0000	-18.000	0.000	NODE
127	NODE	122	2.2500	-17.820	0.000	NODE
128	NODE	123	4.5000	-17.420	0.000	NODE
129	NODE	124	5.50	-17.140	0.000	NODE
130	NODE	125	1.1250	-17.4646	0.0000	NODE
131	NODE	126	3.3750	-17.0807	0.000	NODE
132	NODE	127	1.1250	-17.125	0.000	NODE
133	NODE	128	3.3750	-17.126	0.000	NODE
134	NODE	129	2.2500	-17.125	0.000	NODE
135	END					END
136	RESTG	80	100011			RESTG
137	RESTG	59	100011			RESTG
138	RESTG	54	100011			RESTG
139	RESTG	48	100011			RESTG
140	RESTG	24	100011			RESTG
141	RESTG	18	100011			RESTG
142	RESTG	89	100011			RESTG
143	RESTG	110	100011			RESTG
144	RESTG	116	100011			RESTG
145	RESTG	121	110011			RESTG
146	END					END
147	WGHT	80		17.70		WGHT
148	WGHT	84		17.70		WGHT
149	WGHT	81		35.40		WGHT
150	WGHT	82		35.40		WGHT
151	WGHT	83		35.40		WGHT
152	WGHT	110		35.40		WGHT
153	WGHT	111		70.80		WGHT
154	WGHT	112		35.40		WGHT
155	WGHT	24		17.70		WGHT
156	WGHT	25		35.40		WGHT
157	WGHT	26		35.40		WGHT
158	WGHT	27		35.40		WGHT
159	WGHT	28		17.70		WGHT
160	WGHT	2		35.40		WGHT
161	WGHT	3		70.80		WGHT
162	WGHT	4		70.80		WGHT

*** STARSYNT 3.0 INPUT ***

CARD IMAGE

```
                1   4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80
                .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
CARD NO         ********************************************************************************  CARD TYPE
  163   *GHI        5                   78.80                                                      *GHI
  164   *GHI        6                   39.40                                                      *GHI
  165   *GHI      100                   47.20                                                      *GHI
  166   *GHI      103                   47.20                                                      *GHI
  167   *GHI      101                   94.40                                                      *GHI
  168   *GHI      102                   94.40                                                      *GHI
  169   END                                                                                        END
  170   TRIAD        1        8        15         7        1  1   1.25                           TRIAD
  171   TRIAB        2        7        15        14        1  1   1.25                           TRIAB
  172   TRIAB        3       15        32        14        1  1   1.25                           TRIAB
  173   TRIAB        4       14        32        31        1  1   1.25                           TRIAB
  174   TRIAB        5       32        30        31        1  1   1.25                           TRIAD
  175   TRIAB        6       31        30        35        1  1   1.25                           TRIAB
  176   TRIAD        7       36        42        39        1  1   1.25                           TRIAB
  177   TRIAB        8       39        42        41        1  1   1.25                           TRIAB
  178   TRIAB        9       42        47        41        1  1   1.25                           TRIAB
  179   TRIAD       10       41        47        46        1  1   1.25                           TRIAB
  180   TRIAB       11       41        46        46        1  1   1.25                           TRIAB
  181   TRIAB       12       47        53        46        1  1   1.25                           TRIAB
  182   TRIAB       13       46        53        52        1  1   1.25                           TRIAD
  183   TRIAB       14       53        58        52        1  1   1.25                           TRIAB
  184   TRIAD       15       58        62        57        1  1   1.25                           TRIAB
  185   TRIAB       16       57        62        61        1  1   1.25                           TRIAB
  186   TRIAD       17       57        61        56        1  1   1.25                           TRIAB
  187   TRIAB       18       56        61        60        1  1   1.25                           TRIAD
  188   TRIAB       19       56        60        55        1  1   1.25                           TRIAB
  189   TRIAB       20       55        60        54        1  1   1.25                           TRIAB
  190   TRIAB       21       54        58        57        1  1   1.25                           TRIAB
  191   TRIAD       22       70        67        77        1  1   1.25                           TRIAB
  192   TRIAB       23       69        78        77        1  1   1.25                           TRIAB
  193   TRIAB       24       77        78        86        1  1   1.25                           TRIAB
  194   TRIAB       25       76        87        88        1  1   1.25                           TRIAB
  195   TRIAB       26       88        87        98        1  1   1.25                           TRIAB
  196   TRIAB       27       87        86        97        1  1   1.25                           TRIAB
  197   TRIAB       28       87        97        96        1  1   1.25                           TRIAB
  198   TRIAD       29       96        97       104        1  1   1.25                           TRIAB
  199   TRIAB       30       97       103       104        1  1   1.25                           TRIAD
  200   TRIAB       31      104       103       105        1  1   1.25                           TRIAB
  201   TRIAD       32      103       106       104        1  1   1.25                           TRIAB
  202   TRIAB       33      103       102       108        1  1   1.25                           TRIAD
  203   TRIAD       34      105       120       113        1  1   1.25                           TRIAB
  204   TRIAB       35      106       114       113        1  1   1.25                           TRIAB
  205   TRIAD       36      108       107       114        1  1   1.25                           TRIAB
  206   TRIAB       37      115       114       120        1  1   1.25                           TRIAD
  207   TRIAB       38      120       119       124        1  1   1.25                           TRIAD
  208   TRIAD       39      119       118       124        1  1   1.25                           TRIAD
  209   TRIAB       40      118       123       124        1  1   1.25                           TRIAD
  210   TRIAB       41      123       113       120        1  1   1.25                           TRIAB
  211   TRIAB       42      118       117       126        1  1   1.25                           TRIAB
  212   TRIAB       43      123       124       126        1  1   1.25                           TRIAD
  213   TRIAB       44      126       117       124        1  1   1.25                           TRIAD
  214   TRIAD       49       46        52        49        1  1   1.25                           TRIAB
  215   TRIAB       50       31        35        36        1  1   1.25                           TRIAB
  216   TRIAB       45      124       117       127        1  1   1.25                           TRIAB
```

*** STARDYNE 3.0 INPUT ***

CARD IMAGE

```
CARD NO  1   4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80   CARD TYPE
*******  *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *********
     217 TRIAB      46      125     127     121       1 1   1.25                              TRIAB
     218 TRIAB      47      121     127     116       1 1   1.25                              TRIAB
     219 TRIAB      48      117     116     127       1 1   1.25                              TRIAB
     220 END                                                                                  END
     221 QUADB       1       64       2       1      63       1   1   1.25                   QUADB
     222 QUADB       2       65       3       2      64       1   1   1.25                   QUADB
     223 QUADB       3       66       4       3      65       1   1   1.25                   QUADB
     224 QUADB       4       67       5       4      66       1   1   1.25                   QUADB
     225 QUADB       5       68       6       5      67       1   1   1.25                   QUADB
     226 QUADB       6       69       7       6      68       1   1   1.25                   QUADB
     227 QUADB       7       70       8       7      69       1   1   1.25                   QUADB
     228 QUADB       8        2      10       9       1       1   1   1.25                   QUADB
     229 QUADB       9       10      12      11       9       1   1   1.25                   QUADB
     230 QUADB      10        7      14      13       6       1   1   1.25                   QUADB
     231 QUADB      11       12      17      16      11       1   1   1.25                   QUADB
     232 QUADB      12       17      23      22      16       1   1   1.25                   QUADB
     233 QUADB      13       14      31      30      13       1   1   1.25                   QUADB
     234 QUADB      14       19      25      24      18       1   1   1.25                   QUADB
     235 QUADB      15       20      26      25      19       1   1   1.25                   QUADB
     236 QUADB      16       21      27      26      20       1   1   1.25                   QUADB
     237 QUADB      17       22      28      27      21       1   1   1.25                   QUADB
     238 QUADB      18       23      29      28      22       1   1   1.25                   QUADB
     239 QUADB      19       29      34      33      28       1   1   1.25                   QUADB
     240 QUADB      20       34      38      37      33       1   1   1.25                   QUADB
     241 QUADB      21       38      44      43      37       1   1   1.25                   QUADB
     242 QUADB      22       39      45      44      38       1   1   1.25                   QUADB
     243 QUADB      23       40      46      45      39       1   1   1.25                   QUADB
     244 QUADB      24       44      51      50      43       1   1   1.25                   QUADB
     245 QUADB      25       45      52      51      44       1   1   1.25                   QUADB
     246 QUADB      26       49      55      54      48       1   1   1.25                   QUADB
     247 QUADB      27       50      56      55      49       1   1   1.25                   QUADB
     248 QUADB      28       51      57      56      50       1   1   1.25                   QUADB
     249 QUADB      29       52      58      57      51       1   1   1.25                   QUADB
     250 QUADB      30       72      64      63      71       1   1   1.25                   QUADB
     251 QUADB      31       74      72      71      73       1   1   1.25                   QUADB
     252 QUADB      32       76      69      68      75       1   1   1.25                   QUADB
     253 QUADB      33       79      74      73      78       1   1   1.25                   QUADB
     254 QUADB      34       85      79      78      84       1   1   1.25                   QUADB
     255 QUADB      35       87      76      75      86       1   1   1.25                   QUADB
     256 QUADB      36       90      81      80      89       1   1   1.25                   QUADB
     257 QUADB      37       91      82      81      90       1   1   1.25                   QUADB
     258 QUADB      38       92      83      82      91       1   1   1.25                   QUADB
     259 QUADB      39       93      84      83      92       1   1   1.25                   QUADB
     260 QUADB      40       94      85      84      93       1   1   1.25                   QUADB
     261 QUADB      41       96      94      93      95       1   1   1.25                   QUADB
     262 QUADB      42      100      98      95      99       1   1   1.25                   QUADB
     263 QUADB      43      105     103      99     105       1   1   1.25                   QUADB
     264 QUADB      44      107     101     100     106       1   1   1.25                   QUADB
     265 QUADB      45      108     102     101     107       1   1   1.25                   QUADB
     266 QUADB      46      113     106     105     112       1   1   1.25                   QUADB
     267 QUADB      47      114     107     106     113       1   1   1.25                   QUADB
     268 QUADB      48      117     111     110     116       1   1   1.25                   QUADB
     269 QUADB      49      116     112     111     117       1   1   1.25                   QUADB
     270 QUADB      50      119     113     112     118       1   1   1.25                   QUADB
```

*** NASTRAN 5.0 INPUT ***

CARD IMAGE

```
                1   4   8  12  16  20  24  28  32  36  40  44  48  52  56  60  64  68  72  76  80
                +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +
CARD NO ********************************************************************************  CARD TYPE
    271 QUADR       51      120     114     113     119       1   1   1.25                  QUADR
    272 QUADR       52      126     128     129     122       1   1   1.25                  QUADR
    273 QUADR       53      122     129     127     125       1   1   1.25                  QUADR
    274 END                                                                                 END
    275 ENDGEOM                                                                             ENDGE
    276  STATIC ANALYSIS 0 DEGREE-DEAD WEIGHT                                               STAT
    277 STATIC                                                                              STATI
    278  LOAD CASE 2                                                                         LOAD
    279 ACCEL      -1                  1.0                                                  ACCEL
    280 END                                                                                 END
    281 END CASE                                                                            END C
    282 ALL DONE                                                                            ALL D
    283 OPTION                                                                              OPTIO
    284 OUTPUT         1       2       2       2                                           OUTPU
    285 TAPE4          1                               1   11                              TAPE4
    286 ENDMODEL                                                                           ENDMO
```

```
*****************************************
*                                       *
*        T R S    T A P E    I N F O    *
*                                       *
*                NU13724                *
*                                       *
*  SYM          : AJM1VX8   VSN    : A02769
*  FN           :     1     RN     :     1
*  APW          :           WPW    : ADV
*  DATE READ    :           NO R   :     0
*  DATE WRIT    :           NO W   :     0
*  DATE CERT    :           NO C   :     0
*  DATE ACQ     : 84/09/13  CT     : PU
*  RP           :           PO     :
*  F            :           FA     :
*  TR           :           D      :
*  LB           :           CV     :
*  ALTVSN       :           WPO    :
*  W            : W         FLAGS  : L/U/N
*  L            : DISK2495
*  COM          :
*                                       *
*****************************************
```

```
AJMINMW, A9/10/C9, O P T I C O M  CYBER  SERVICES.          NOS 1.4 552/552*.

20.38.54.BWF,P2,I700.
20.38.54.USER,NU1672**.
20.38.54.CHARGE,F33V5JT,*046*.
20.38.54.ROUTE,OUTPUT,DC=PR,DEF,FID=BWF27.
20.38.54. ROUTE COMPLETE.
20.38.55.IRS,LFN=BF,R,UP=R,SYN=AJMIVXB.
20.38.57.LABEL(BF,PD=R,L=1DISK249S          $,VSN=A02965)
20.39.34.NI31, ASSIGNED TO BF      , VSN=A02969.
20.39.34.SKIPF,BF,2,B.
20.39.34.COPYBF,BF,TAPE4.
20.39.35. COPY COMPLETE.
20.39.35.REWIND,TAPE4.
20.39.35.GET,APPLIC/UN=LIBRARY.
20.39.37.BEGIN,POST4,APPLIC.
20.39.39.$BEGIN,LOGO,APPLIC,INPUT,POST4,$1.2.0$.
20.39.41.RETURN,LOGO,QABLK2.
20.39.41.ATTACH,LOGO/UN=LIBRARY,M=E,PW=.
20.39.42.LOGO.      POST4,1.2.0
20.39.42.      END  LOGO
20.39.42.     020600 MAXIMUM EXECUTION FL.
20.39.42.      0.140 CP SECONDS EXECUTION TIME.
20.39.42.RETURN,LOGO.
20.39.42.ATTACH,QABLK2/UN=LIBRARY,M=E,PW=.
20.39.43.QABLK2.      POST4,1.2.0
20.39.43.     STOP
20.39.43.     022300 MAXIMUM EXECUTION FL.
20.39.43.      0.149 CP SECONDS EXECUTION TIME.
20.39.43.RETURN,QABLK2.
20.39.44.REVERT.
20.39.44.$RETURN,OLA.
20.39.44.$ATTACH,OLA=OLA4/UN=LIBRARY,M=E,PW=.
20.39.44.$REWIND,OLA.
20.39.44.$REVERT.     POST4 ATTACHED (LFN=OLA)
20.39.44.OLA,PL=99999.
20.39.46. START APPLICATION  OPT2
20.39.46. * * *   P O S T 4   * * *
20.39.46. *      VERSION  1.2       *
20.39.46. * *     LEVEL 07JANF2     *
20.39.51. * *  E N D  P O S T 4  * *
20.39.51.     STOP
20.39.51.     114700   FINAL EXECUTION FL.
20.39.51.      2.132 CP SECONDS EXECUTION TIME.
20.39.51. REPRIEVED NORMAL TERMINATION.
20.39.51. JOB REPRIEVED.
20.39.51.      1.380 SRUS USED BY APPLICATION
20.39.51. RPV - PREVIOUS ERROR CONDITIONS RESET.
20.39.51.RETURN,BF.
20.39.51.GOTO,1.
20.39.52.1,DAYFILE,DAY.
20.39.52. USER DAYFILE PROCESSED.
20.39.52.REPLACE,DAY.
20.39.52.UEAD=       0.003KUNS.
20.39.52.UEPF=       0.176KUNS.
20.39.52.UEMT=       0.065KUNS.
20.39.52.UEMS=       8.852KUNS.
20.39.52.UECP=       3.287SECS.
20.39.52.AESR=       6.910UNTS.
20.40.21.UCLP= AA2G=       0.917KLNS.
```

18 POST

```
                              * * *  POST4      1.2        INPUT  * * *

                    /---------------------------------- CARD IMAGE ----------------------------------/
                    1    5    10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
                    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *
CARD NO             ********************************************************************************

      1  TITLE      SPACE8 DISK STRESS INTENSITY EVALUATION ~~BEST~~ WEIGHT
      2  SEL-VECTORSG    1    1    1                          DEAD
      3  SEL-TPLTSTSG    1   48    1
      4  SEL-RPLTSTSG    1   53    1
      5  LIST       1    1    1    2    3    4    5    6   10   11   12
      6  WRITE70
```

DEAD

18 POST

POST4 *** SPACE DISK STRESS INTENSITY EVALUATION DEAD WEIGHT ***

SCALE FACTOR = .1000E+01
FLAG TO WRITE TAPE70 = 1

SELECTED LIST OPTIONS = 1 2 3 4 5 6 10 11 12 8 9

OPTION = 1	SXP	NORMAL STRESS - LOCAL X - + FACE
= 2	SYP	NORMAL STRESS - LOCAL Y - + FACE
= 3	SXYP	SHEAR STRESS - LOCAL XY - + FACE
= 4	SXN	NORMAL STRESS - LOCAL X - - FACE
= 5	SYN	NORMAL STRESS - LOCAL Y - - FACE
= 6	SXYN	SHEAR STRESS - LOCAL XY - - FACE
= 7	SXM	MEMBRANE NORMAL STRESS - LOCAL X
= 8	SYM	MEMBRANE NORMAL STRESS - LOCAL Y
= 9	SXYM	MEMBRANE SHEAR STRESS - LOCAL XY
= 10	SIP	STRESS INTENSITY - + FACE
= 11	SIN	STRESS INTENSITY - - FACE
= 12	SIM	MEMBRANE STRESS INTENSITY
= 13	S1P	MAXIMUM PRINCIPAL STRESS - + FACE
= 14	S2P	MINIMUM PRINCIPAL STRESS - + FACE
= 15	S3P	PRINCIPAL STRESS DIFF. - + FACE
= 16	S1N	MAXIMUM PRINCIPAL STRESS - - FACE
= 17	S2N	MINIMUM PRINCIPAL STRESS - - FACE
= 18	S3N	PRINCIPAL STRESS DIFF. - FACE
= 19	S1M	MAXIMUM MEMBRANE STRESS
= 20	S2M	MINIMUM MEMBRANE STRESS
= 21	S3M	MEMBRANE PRINCIPAL STRESS DIFF.
= 22	S12MAXP	MAX. ABS. PRINCIPAL STRESS - + FACE
= 23	S12MAXN	MAX. ABS. PRINCIPAL STRESS - - FACE
= 24	S12MAXM	MAX. ABS. MEMBRANE STRESS
= 25	SIMAXEF	MAX. OF MAX. STRESS INTEN. - E.F.
= 26	S1MAXEF	MAX. OF MAX. PRIN. STRESSES - E.F.
= 27	S1MINEF	MIN. OF MAX. PRIN. STRESSES - E.F.
= 28	S2MAXEF	MAX. OF MIN. PRIN. STRESSES - E.F.
= 29	S2MINEF	MIN. OF MIN. PRIN. STRESSES - E.F.
= 30	S1AMAXEF	MAX. OF ABS. MAX. PRINCIPAL STRESSES
= 31	S2AMAXEF	MAX. OF ABS. MIN. PRINCIPAL STRESSES
= 32	THETAM	AXIS ANGLE OF PRIN. MEMB. STRESSES
= 33	SXB	BENDING STRESS - LOCAL X
= 34	SYB	BENDING STRESS - LOCAL Y
= 35	SXZ	TRANSVERSE SHEAR XZ
= 36	SYZ	TRANSVERSE SHEAR YZ

FLAG TO PRINT VECTORS = 1
OUTPUT FORMAT FOR LIST OPTION = 1
FORMAT 1 = (1X,I4,5X,1P,11(E10.3,1X))
FORMAT 2 = (1X,I4,5X,11(F10.0,1X))
FORMAT 3 = (1X,I4,5X,11(F10.4,1X))

SPACER DISK STRESS INTENSITY EVALUATION [redacted] WEIGHT
LOAD CASE 2

TPLTSTS ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYP
1	-6.910E+01	1.320E+01	9.399E+00	-6.910E+01	1.320E+01	9.399E+00	8.442E+01	8.442E+01	8.442E+01	1.320E+01	9.399E+00
2	-2.779E+01	4.630E+01	-1.353E+00	-2.779E+01	4.630E+01	-1.353E+00	7.415E+01	7.415E+01	7.415E+01	4.630E+01	-1.353E+00
3	-1.084E+02	1.180E+01	-2.114E+01	-1.084E+02	1.180E+01	-2.114E+01	1.274E+02	1.274E+02	1.274E+02	1.180E+01	-2.114E+01
4	-2.464E+01	1.346E+01	1.476E+01	-2.464E+01	1.346E+01	1.476E+01	4.820E+01	4.820E+01	4.820E+01	1.346E+01	1.476E+01
5	-9.872E+01	3.207E+01	-5.339E+01	-9.872E+01	3.207E+01	-5.339E+01	1.688E+02	1.688E+02	1.688E+02	3.207E+01	-5.339E+01
6	-1.377E+01	2.884E+01	5.508E+01	-1.377E+01	2.884E+01	5.508E+01	1.181E+02	1.181E+02	1.181E+02	2.884E+01	5.508E+01
7	-6.367E+01	8.276E+01	-3.938E+01	-6.367E+01	8.276E+01	-3.938E+01	1.663E+02	1.663E+02	1.663E+02	8.276E+01	-3.938E+01
8	1.116E+02	1.562E+02	2.792E+02	1.116E+02	1.562E+02	2.792E+02	5.603E+02	5.603E+02	5.603E+02	1.562E+02	2.792E+02
9	-4.146E+02	3.666E+02	-2.316E+02	-4.146E+02	3.666E+02	-2.316E+02	9.082E+02	9.082E+02	9.082E+02	3.666E+02	-2.316E+02
10	6.077E+01	-5.313E+01	6.704E+01	6.077E+01	-5.313E+01	6.704E+01	1.759E+02	1.759E+02	1.759E+02	-5.313E+01	6.704E+01
11	7.086E+01	-1.398E+01	4.494E+00	7.086E+01	-1.398E+01	4.494E+00	8.531E+01	8.531E+01	8.531E+01	-1.398E+01	4.494E+00
12	3.239E+01	-2.687E+01	-1.169E+01	3.239E+01	-2.687E+01	-1.169E+01	6.371E+01	6.371E+01	6.371E+01	-2.687E+01	-1.169E+01
13	3.307E+01	4.535E+01	2.216E+01	3.307E+01	4.535E+01	2.216E+01	6.221E+01	6.221E+01	6.221E+01	4.535E+01	2.216E+01
14	8.125E+01	1.089E+01	-2.129E+01	8.125E+01	1.089E+01	-2.129E+01	8.719E+01	8.719E+01	8.719E+01	1.089E+01	-2.129E+01
15	2.099E+02	-9.277E+01	-6.628E+01	2.099E+02	-9.277E+01	-6.628E+01	3.304E+02	3.304E+02	3.304E+02	-9.277E+01	-6.628E+01
16	8.041E+01	3.778E+02	2.172E+01	8.041E+01	3.778E+02	2.172E+01	3.794E+02	3.794E+02	3.794E+02	3.778E+02	2.172E+01
17	1.236E+02	-1.154E+02	7.984E+01	1.236E+02	-1.154E+02	7.984E+01	2.874E+02	2.874E+02	2.874E+02	-1.154E+02	7.984E+01
18	9.841E+00	2.844E+02	-9.010E+00	9.841E+00	2.844E+02	-9.010E+00	2.846E+02	2.846E+02	2.846E+02	2.844E+02	-9.010E+00
19	1.464E+02	-2.384E+01	3.645E+00	1.464E+02	-2.384E+01	3.645E+00	1.704E+02	1.704E+02	1.704E+02	-2.384E+01	3.645E+00
20	6.373E+00	2.037E+01	-5.273E+01	6.373E+00	2.037E+01	-5.273E+01	1.064E+02	1.064E+02	1.064E+02	2.037E+01	-5.273E+01
21	1.043E+02	9.146E+01	-1.314E+02	1.043E+02	9.146E+01	-1.314E+02	2.631E+02	2.631E+02	2.631E+02	9.146E+01	-1.314E+02
22	-6.048E+00	2.444E+00	-2.340E+01	-6.048E+00	2.444E+00	-2.340E+01	4.757E+01	4.757E+01	4.757E+01	2.444E+00	-2.340E+01
23	1.146E+01	-1.419E+01	1.976E+01	1.146E+01	-1.419E+01	1.976E+01	4.711E+01	4.711E+01	4.711E+01	-1.419E+01	1.976E+01
24	-4.053E+00	4.524E+01	3.102E-01	-4.053E+00	4.524E+01	3.102E-01	4.929E+01	4.929E+01	4.929E+01	4.524E+01	3.102E-01
25	2.122E+01	-9.748E+00	1.798E+01	2.122E+01	-9.748E+00	1.798E+01	4.746E+01	4.746E+01	4.746E+01	-9.748E+00	1.798E+01
26	5.847E+00	7.320E+01	4.111E+01	5.847E+00	7.320E+01	4.111E+01	1.063E+02	1.063E+02	1.063E+02	7.320E+01	4.111E+01
27	-2.166E+00	-8.537E+01	-1.218E+01	-2.166E+00	-8.537E+01	-1.218E+01	8.711E+01	8.711E+01	8.711E+01	-8.537E+01	-1.218E+01
28	-4.563E+01	4.487E+01	4.871E+01	-4.563E+01	4.487E+01	4.871E+01	1.331E+02	1.331E+02	1.331E+02	4.487E+01	4.871E+01
29	-1.633E+01	1.029E+02	8.086E+01	-1.633E+01	1.029E+02	8.086E+01	2.009E+02	2.009E+02	2.009E+02	1.029E+02	8.086E+01
30	-2.643E+02	2.597E+01	3.152E+02	-2.643E+02	2.597E+01	3.152E+02	6.941E+02	6.941E+02	6.941E+02	2.597E+01	3.152E+02
31	8.729E+01	-5.991E+01	7.862E+02	8.729E+01	-5.991E+01	7.862E+02	1.579E+03	1.579E+03	1.579E+03	-5.991E+01	7.862E+02
32	-2.711E+01	1.226E+02	-1.072E+02	-2.711E+01	1.226E+02	-1.072E+02	2.615E+02	2.615E+02	2.615E+02	1.226E+02	-1.072E+02
33	-9.732E+01	-1.930E+01	-1.089E+01	-9.732E+01	-1.930E+01	-1.089E+01	9.881E+01	9.881E+01	9.881E+01	-1.930E+01	-1.089E+01
34	1.841E+01	-1.591E+01	2.269E+01	1.841E+01	-1.591E+01	2.269E+01	5.689E+01	5.689E+01	5.689E+01	-1.591E+01	2.269E+01
35	2.470E-01	3.455E+01	-6.450E+00	2.470E-01	3.455E+01	-6.450E+00	3.665E+01	3.665E+01	3.665E+01	3.455E+01	-6.450E+00
36	4.360E+00	4.786E+01	-1.822E+01	4.360E+00	4.786E+01	-1.822E+01	5.674E+01	5.674E+01	5.674E+01	4.786E+01	-1.822E+01
37	1.123E+01	1.637E+01	5.672E+01	1.123E+01	1.637E+01	5.672E+01	1.136E+02	1.136E+02	1.136E+02	1.637E+01	5.672E+01
38	4.882E+01	-5.248E+01	-1.942E+01	4.882E+01	-5.248E+01	-1.942E+01	1.085E+02	1.085E+02	1.085E+02	-5.248E+01	-1.942E+01
39	4.438E+01	-5.808E+01	-1.381E+02	4.438E+01	-5.808E+01	-1.381E+02	2.946E+02	2.946E+02	2.946E+02	-5.808E+01	-1.381E+02
40	-5.627E+00	-1.503E+02	1.911E+02	-5.627E+00	-1.503E+02	1.911E+02	4.086E+02	4.086E+02	4.086E+02	-1.503E+02	1.911E+02
41	-7.082E+01	-3.676E+02	1.745E+02	-7.082E+01	-3.676E+02	1.745E+02	4.582E+02	4.582E+02	4.582E+02	-3.676E+02	1.745E+02
42	-8.897E+01	-1.146E+02	-2.801E+02	-8.897E+01	-1.146E+02	-2.801E+02	5.608E+02	5.608E+02	5.608E+02	-1.146E+02	-2.801E+02
43	-2.465E+02	-1.161E+02	-2.484E+02	-2.465E+02	-1.161E+02	-2.484E+02	5.136E+02	5.136E+02	5.136E+02	-1.161E+02	-2.484E+02
44	1.332E+02	-5.094E+02	-3.759E+02	1.332E+02	-5.094E+02	-3.759E+02	9.891E+02	9.891E+02	9.891E+02	-5.094E+02	-3.759E+02
45	4.710E+01	-6.461E+02	1.655E+02	4.710E+01	-6.461E+02	1.655E+02	7.681E+02	7.681E+02	7.681E+02	-6.461E+02	1.655E+02
46	-1.812E+02	-1.461E+03	3.894E+02	-1.812E+02	-1.461E+03	3.894E+02	1.570E+03	1.570E+03	1.570E+03	-1.461E+03	3.894E+02
47	-1.331E+03	-2.029E+02	-1.531E+02	-1.331E+03	-2.029E+02	-1.531E+02	1.352E+03	1.352E+03	1.352E+03	-2.029E+02	-1.531E+02
48	-1.636E+02	-4.202E+02	-2.903E+02	-1.636E+02	-4.202E+02	-2.903E+02	6.348E+02	6.348E+02	6.348E+02	-4.202E+02	-2.903E+02

SPACER DISK STRESS INTENSITY EVALUATION [redacted] WEIGHT
LOAD CASE 2

TPLTSTS ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
MAXIMUM	2.099E+02	3.778E+02	7.862E+02	2.099E+02	3.778E+02	7.862E+02	1.579E+03	1.579E+03	1.579E+03	3.778E+02	7.862E+02
ELEMENT	15	16	31	15	16	31	31	31	31	16	31
MINIMUM	-1.331E+03	-1.461E+03	-3.759E+02	-1.331E+03	-1.461E+03	-3.759E+02	3.665E+01	3.665E+01	3.665E+01	-1.461E+03	-3.759E+02
ELEMENT	47	46	44	47	46	44	35	35	35	46	44

SPACER DISK STRESS INTENSITY EVALUATION [redacted] WEIGHT
LOAD CASE 2

RPLISTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYP
1	-2.922E+02	1.345E+01	-1.658E+02	-2.922E+02	1.345E+01	-1.658E+02	4.510E+02	4.510E+02	4.510E+02	1.345E+01	-1.658E+02
2	-2.541E+01	3.461E+01	9.562E+01	-2.541E+01	3.461E+01	9.562E+01	2.004E+02	2.004E+02	2.004E+02	3.461E+01	9.562E+01
3	-7.885E+00	3.461E+01	3.834E+01	-7.885E+00	3.461E+01	3.834E+01	8.767E+01	8.767E+01	8.767E+01	3.461E+01	3.834E+01
4	-1.857E+01	3.461E+01	-1.894E+01	-1.857E+01	3.461E+01	-1.894E+01	6.529E+01	6.529E+01	6.529E+01	3.461E+01	-1.894E+01
5	6.645E+00	3.461E+01	-7.622E+01	6.645E+00	3.461E+01	-7.622E+01	1.550E+02	1.550E+02	1.550E+02	3.461E+01	-7.622E+01
6	3.538E+01	5.303E+00	2.642E+01	3.538E+01	5.303E+00	2.642E+01	6.080E+01	6.080E+01	6.080E+01	5.303E+00	2.642E+01
7	-2.261E+01	7.460E+00	2.814E+01	-2.261E+01	7.460E+00	2.814E+01	6.381E+01	6.381E+01	6.381E+01	7.460E+00	2.814E+01
8	-2.521E+02	6.814E+01	6.824E+00	-2.521E+02	6.814E+01	6.824E+00	3.205E+02	3.205E+02	3.205E+02	6.814E+01	6.824E+00
9	-2.518E+02	-2.114E+01	6.824E+00	-2.518E+02	-2.114E+01	6.824E+00	2.520E+02	2.520E+02	2.520E+02	-2.114E+01	6.824E+00
10	1.004E+02	3.186E+01	-9.990E+00	1.004E+02	3.186E+01	-9.990E+00	1.018E+02	1.018E+02	1.018E+02	3.186E+01	-9.990E+00
11	-2.515E+02	1.643E+01	6.824E+00	-2.515E+02	1.643E+01	6.824E+00	2.683E+02	2.683E+02	2.683E+02	1.643E+01	6.824E+00
12	-2.513E+02	-4.457E+01	6.824E+00	-2.513E+02	-4.457E+01	6.824E+00	2.515E+02	2.515E+02	2.515E+02	-4.457E+01	6.824E+00
13	1.074E+02	-6.906E+00	1.784E+01	1.074E+02	-6.906E+00	1.784E+01	1.198E+02	1.198E+02	1.198E+02	-6.906E+00	1.784E+01
14	-1.177E+01	-1.183E+01	-1.432E+01	-1.177E+01	-1.183E+01	-1.432E+01	2.864E+01	2.864E+01	2.864E+01	-1.183E+01	-1.432E+01
15	-1.669E+01	-1.183E+01	-4.296E+01	-1.669E+01	-1.183E+01	-4.296E+01	8.605E+01	8.605E+01	8.605E+01	-1.183E+01	-4.296E+01
16	3.003E+00	-1.183E+01	-7.160E+01	3.003E+00	-1.183E+01	-7.160E+01	1.440E+02	1.440E+02	1.440E+02	-1.183E+01	-7.160E+01
17	-7.084E+01	-1.183E+01	-1.002E+02	-7.084E+01	-1.183E+01	-1.002E+02	2.090E+02	2.090E+02	2.090E+02	-1.183E+01	-1.002E+02
18	-1.420E+02	-1.219E+01	1.119E+02	-1.420E+02	-1.219E+01	1.119E+02	2.588E+02	2.588E+02	2.588E+02	-1.219E+01	1.119E+02
19	-1.360E+02	3.004E+01	1.865E+01	-1.360E+02	3.004E+01	1.865E+01	1.702E+02	1.702E+02	1.702E+02	3.004E+01	1.865E+01
20	-1.354E+02	-2.822E+01	1.865E+01	-1.354E+02	-2.822E+01	1.865E+01	1.386E+02	1.386E+02	1.386E+02	-2.822E+01	1.865E+01
21	-4.950E+00	2.004E+01	-3.504E+01	-4.950E+00	2.004E+01	-3.504E+01	7.440E+01	7.440E+01	7.440E+01	2.004E+01	-3.504E+01
22	-5.201E+01	-3.066E+01	6.541E+00	-5.201E+01	-3.066E+01	6.541E+00	5.386E+01	5.386E+01	5.386E+01	-3.066E+01	6.541E+00
23	1.848E+01	-1.779E+01	7.779E+00	1.848E+01	-1.779E+01	7.779E+00	3.947E+01	3.947E+01	3.947E+01	-1.779E+01	7.779E+00
24	-1.364E+02	-6.392E+01	-4.879E+01	-1.384E+02	-6.392E+01	-4.879E+01	1.626E+02	1.626E+02	1.626E+02	-6.392E+01	-4.879E+01
25	8.303E+00	-2.227E+01	-1.830E+01	6.303E+00	-2.227E+01	-1.830E+01	4.769E+01	4.769E+01	4.769E+01	-2.227E+01	-1.830E+01
26	2.562E+00	-1.045E+02	3.359E+00	2.562E+00	-1.045E+02	3.359E+00	1.073E+02	1.073E+02	1.073E+02	-1.045E+02	3.359E+00
27	-4.471E+01	-1.209E+02	-3.408E+01	-4.471E+01	-1.209E+02	-3.408E+01	1.340E+02	1.340E+02	1.340E+02	-1.209E+02	-3.408E+01
28	-4.131E+01	-2.275E+01	3.286E+01	-4.131E+01	-2.275E+01	3.286E+01	6.830E+01	6.830E+01	6.830E+01	-2.275E+01	3.286E+01
29	2.448E+01	5.843E+01	5.529E+01	2.448E+01	5.843E+01	5.529E+01	1.157E+02	1.157E+02	5.843E+01	5.529E+01	
30	-3.769E+02	-6.332E+01	-2.779E+01	-3.769E+02	-6.332E+01	-2.779E+01	3.794E+02	3.794E+02	3.794E+02	-6.332E+01	-2.779E+01
31	-3.772E+02	2.020E+01	-2.779E+01	-3.772E+02	2.020E+01	-2.779E+01	4.013E+02	4.013E+02	4.013E+02	2.020E+01	-2.779E+01
32	-4.864E+00	-1.949E+01	5.167E+00	-4.864E+00	-1.949E+01	5.167E+00	2.113E+01	2.113E+01	2.113E+01	-1.949E+01	5.167E+00
33	-3.775E+02	-1.747E+01	-2.779E+01	-3.775E+02	-1.747E+01	-2.779E+01	3.796E+02	3.796E+02	3.796E+02	-1.747E+01	-2.779E+01
34	-3.778E+02	4.967E+01	-2.779E+01	-3.778E+02	4.967E+01	-2.779E+01	4.310E+02	4.310E+02	4.310E+02	4.967E+01	-2.779E+01
35	-2.593E+01	4.810E+00	2.023E+01	-2.590E+01	4.810E+00	2.023E+01	5.080E+01	5.080E+01	5.080E+01	4.810E+00	2.023E+01
36	-1.320E+01	9.616E+01	-1.432E+01	-1.320E+01	9.616E+01	-1.432E+01	1.131E+02	1.131E+02	1.131E+02	9.616E+01	-1.432E+01
37	-9.496E+00	9.616E+01	-4.296E+01	-9.496E+00	9.616E+01	-4.296E+01	1.362E+02	1.362E+02	1.362E+02	9.616E+01	-4.296E+01
38	-2.433E+01	9.616E+01	-7.160E+01	-2.433E+01	9.616E+01	-7.160E+01	1.871E+02	1.871E+02	1.871E+02	9.616E+01	-7.160E+01
39	3.130E+01	9.616E+01	-1.002E+02	3.130E+01	9.616E+01	-1.002E+02	2.107E+02	2.107E+02	2.107E+02	9.616E+01	-1.002E+02
40	-4.743E+02	3.754E+01	1.084E+02	-4.743E+02	3.754E+01	1.084E+02	5.559E+02	5.559E+02	5.559E+02	3.754E+01	1.084E+02
41	-4.930E+02	-2.533E+01	6.837E+01	-4.930E+02	-2.533E+01	6.837E+01	5.028E+02	5.028E+02	5.028E+02	-2.533E+01	6.837E+01
42	-4.936E+02	4.292E+01	6.837E+01	-4.936E+02	4.292E+01	6.837E+01	5.537E+02	5.537E+02	4.292E+01	6.837E+01	
43	-4.959E+02	7.436E-01	-1.448E+02	-4.959E+02	7.436E-01	-1.448E+02	5.749E+02	5.749E+02	5.749E+02	7.436E-01	-1.448E+02
44	-5.350E+01	4.533E+01	5.985E+01	-5.350E+01	4.533E+01	5.985E+01	1.552E+02	1.552E+02	1.552E+02	4.533E+01	5.985E+01
45	-4.673E+00	-2.436E+01	4.830E+01	-4.673E+00	-2.436E+01	4.830E+01	9.467E+01	9.467E+01	9.467E+01	-2.436E+01	4.830E+01
46	-4.026E+02	-4.433E+01	7.345E+01	-4.026E+02	-4.433E+01	7.345E+01	4.171E+02	4.171E+02	4.171E+02	-4.433E+01	7.345E+01
47	-1.402E+02	-8.551E+01	7.683E+00	-1.402E+02	-8.551E+01	7.683E+00	1.413E+02	1.413E+02	1.413E+02	-8.551E+01	7.683E+00
48	-8.909E+01	6.125E+02	1.494E+02	-8.909E+01	6.125E+02	1.494E+02	7.626E+02	7.626E+02	7.626E+02	6.125E+02	1.494E+02
49	-1.083E+02	2.274E+02	2.440E+02	-1.083E+02	2.274E+02	2.440E+02	5.923E+02	5.923E+02	5.923E+02	2.274E+02	2.440E+02
50	-2.115E+02	2.020E+01	1.445E+02	-2.115E+02	2.020E+01	1.445E+02	3.704E+02	3.704E+02	3.704E+02	2.020E+01	1.445E+02
51	-8.581E+01	2.106E+01	1.943E+01	-8.581E+01	2.106E+01	1.943E+01	1.137E+02	1.137E+02	1.137E+02	2.106E+01	1.943E+01

SPACER DISK STRESS INTENSITY EVALUATION [redacted] WEIGHT
LOAD CASE 2

RPLTSTS

ELEM	SXP	SYP	SXYP	SXN	SYN	SXYN	SIP	SIN	SIM	SYM	SXYM
52	-3.354E+01	-6.760E+02	1.704E+02	-3.354E+01	-6.760E+02	1.704E+02	7.273E+02	7.273E+02	7.273E+02	-6.760E+02	1.704E+02
53	-2.008E+01	-8.695E+02	1.685E+02	-2.008E+01	-8.695E+02	1.685E+02	9.138E+02	9.138E+02	9.138E+02	-8.695E+02	1.685E+02
MAXIMUM	1.674E+02	6.125E+02	2.440E+02	1.074E+02	6.125E+02	2.440E+02	9.138E+02	9.138E+02	9.138E+02	6.125E+02	2.440E+02
ELEMENT	13	48	49	13	48	49	53	53	53	48	49
MINIMUM	-4.959E+02	-8.695E+02	-1.658E+02	-4.959E+02	-8.695E+02	-1.658E+02	2.113E+01	2.113E+01	2.113E+01	-8.695E+02	-1.658E+02
ELEMENT	43	53	1	43	53	1	32	32	32	53	1

PROJECT NUHOMS GENERIC DESIGN FILE NO. ADV001
OWNER NUTECH INC.
CLIENT NUTECH INC.

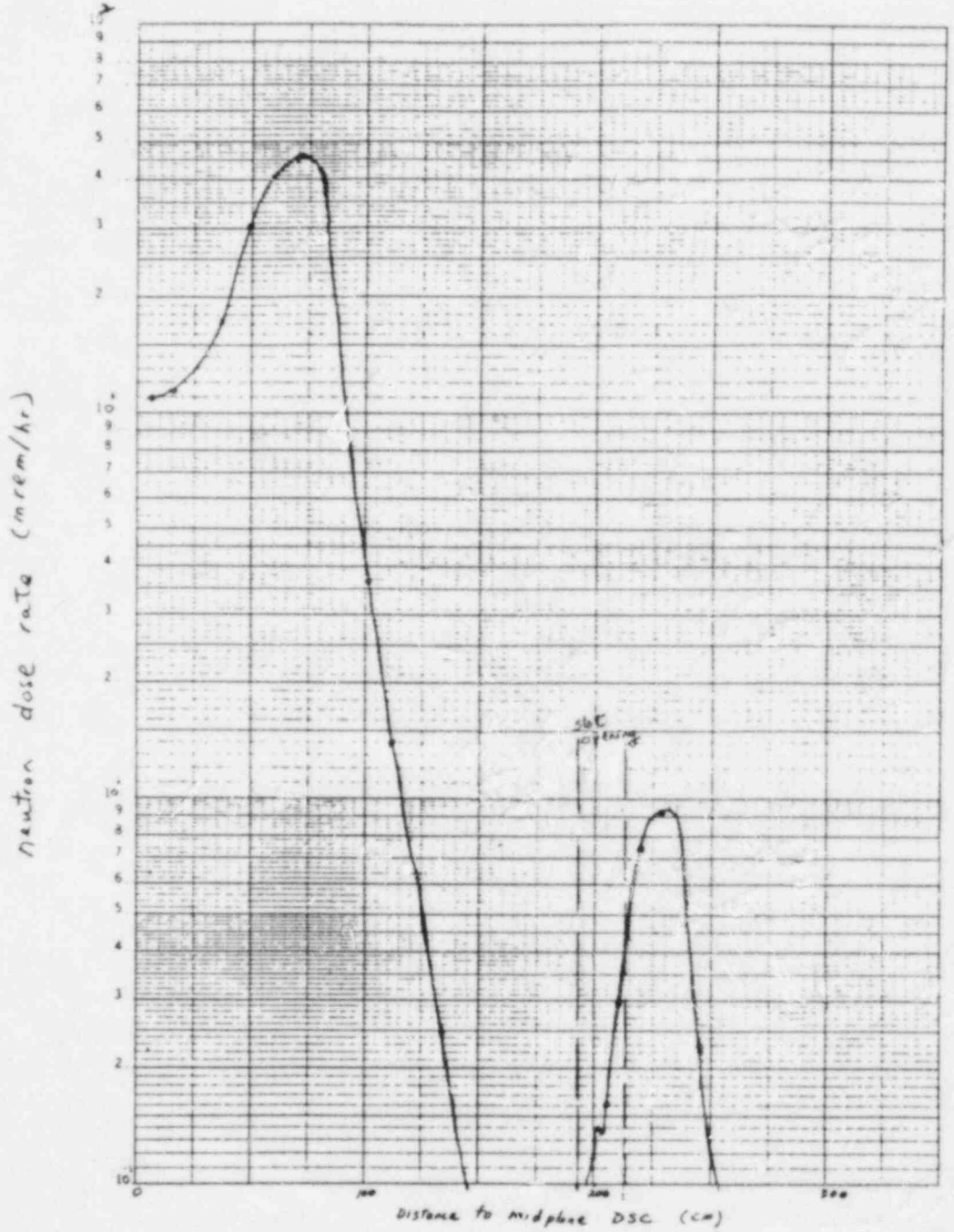


FIGURE 8 Neutron Dose Along Roof ℄

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Enclosure 6

Problem Set 5 is a difficult void-streaming problem, having a sodium-filled pipe, surrounded by a streaming gap, penetrating a concrete wall. In the original geometry, insulation surrounded the pipe, but this space has been filled with steel to make the problem more severe. The void has an offset step after roughly 60% of its traverse. A space mesh with 15 radial intervals is used below the offset, while 28 intervals are used above. A quadrature set having 30 directions is used, except that an upward-biased, 166-direction set is used in the void. Studies have shown that the 30-direction set gives poor results if used in the void, but the illustrated solution gives nearly the same result as a solution having 166 directions everywhere and a uniform radial mesh, and it does it in less than half as much time. The cross sections are 14-group P_3, but only the first group is solved in the illustration.

COST REDUCTION WITH VARIABLE MESH AND QUADRATURE

A void-streaming problem illustrates the use of the variable space mesh and variable quadrature features. The basic problem, shown in Fig. 2 represents a thick, sodium-filled steel cylinder penetrating a concrete wall. A uniform source is applied at the bottom boundary, and the result of interest is the flux at the top of the void gap. Table 1 shows some pertinent data from several modes of solution. In the table, S6 refers to a half-symmetrical S6 directional quadrature having 30 direction segments, while U166 refers to a 166-direction biased set with 131 directions upward. The 2nd dimension has 35 mesh intervals. Times are for execution with the weighted-difference model on the IBM 360/91.

Comparing problems 1 and 2, the use of 166 directions only in the void does not affect the result of interest, but saves time. Problem 3 shows that the full direction set is required for propagation through the void, however. Problem 4 shows that the 30-direction S6 is totally inadequate by itself. Problem 5 shows that a coarse-mesh rebalance (produces the same result as the fine mesh.

No.	General Quadrature	Zones 1&2	Zones 5,6,7	I-Intervals Zones 1-8	I-Intervals Zones 9-16	Rebalance Mesh	Execution Time(min)	Iterations	Flux at Top of Gap	Comments
1	U166	U166	U166	28	28	28x35	2.07	8	0.20	Base Case
2	S6	U166	U166	28	28	28x35	1.33	8	0.20	Reduced General Quadrature
3	S6	U166	S6	28	28	28x35	1.06	8	0.14	Reduced Quadrature, Zones 5, 6, 7
4	S6	S6	S6	28	28	28x35	0.62	8	0.0079	S6 in all zones
5	S6	U166	U166	28	28	15x28	1.31	8	0.20	Coarse-Mesh Rebalance
6	S6	U166	U166	15	28	15x28	0.94	8	0.22	Variable Space Mesh
7	U166	U166	U166	28	28	28x35	1.70	8	0.20	Run with I,M Ordering in Flux Calculations

Table 1

Problem 6 shows that the variable-quadrature-variable-mesh combination gives good results at a bargain price. Problem 7 is the same result as problem 1 run with an alternate flux routine which does not allow variable quadrature. Apparently this feature costs an 18% penalty in execution speed. In really large problems, however, this penalty would not be significant in comparison to the savings obtained. Even in this small example, problems 2 and 6 were both less expensive than 7.

004155

FROM BLDG 3301 2 2203 9. 6.1985 16:07 P. 2

TEST SAMPLE - DOTIOS TEST REPORT 09/06/85

PIPE CHASE PROBLEM FOR DOT-IV 4.3 VERSION 1.01 (BCS 1.0.0)
COMPARISON OF RESULTS WITH OAK RIDGE RESULTS

DEFAULT VALUES ON THE OAK RIDGE VERSION WERE DIFFERENT THAN THE CURRENT BCS VERSION. THE INPUT WAS MODIFIED TO OVERRIDE THE DEFAULT VALUES AS FOLLOWS-

VARIABLE	DESCRIPTION	BCS DEFAULT	CHANGED TO ORNL DEFAULT
MODE	SOLUTION TECHNIQUE	VECTOR WEIGHTED	THETA WEIGHTED
NEGFIX	FIXUP TECHNIQUE	ECONOMY	NONE
WSOL01	REBAL. SCATTER RATIO	.3	0.
FLXMIN	MIN. FLUX CONVERGENCE	1.E-60	1.E-30
EXTRCV	EXTRAP. CONVERGENCE	.2	.1

IN ADDITION, THE ITERATION SCHEME AS IT IS EXECUTED ON THE CRAY VERSION AT BCS TOOK ADDITIONAL ITERATION STEPS TO CONVERGE. THE MAXIMUM ITERATIONS PER GROUP HAD TO BE INCREASED TO 20 IN ORDER TO GET THE PROBLEM TO MEET THE FLUX CONVERGENCE CRITERIA (1.E-2).

AFTER EXECUTION OF THE MODIFIED PROBLEM, THE FOLLOWING DIFFERENCES WERE OBSERVED IN THE GROUPWISE BALANCE SUMMARY.

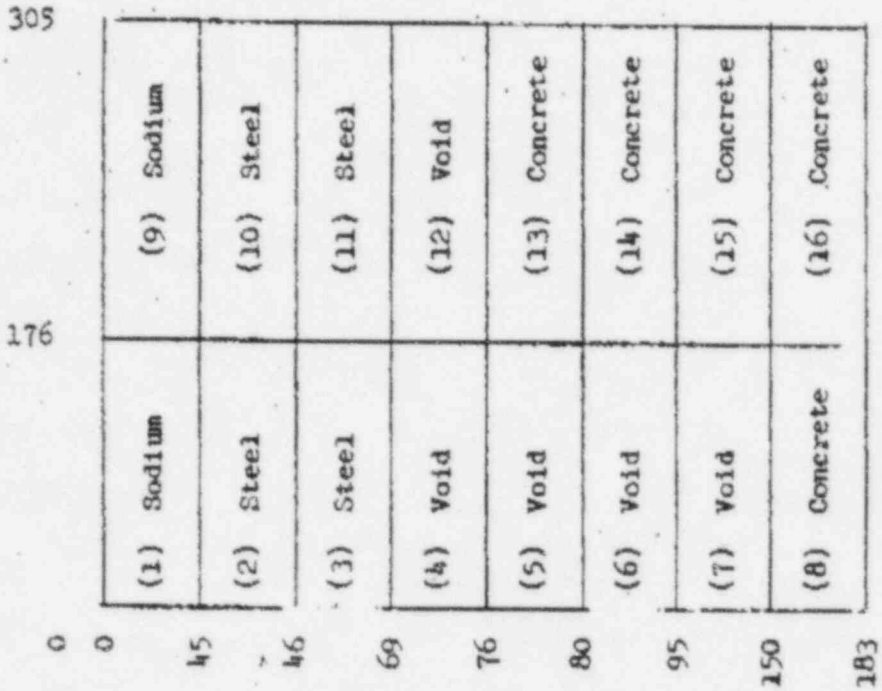
VALUE DESCRIPTION	BCS RESULTS	OAK RIDGE RESULTS	DEVIATION	PERCENT
SNESCAT/COL	.665303	.665285	.000018	.0027
OUTSCATTER	1950430	1949280	1150	.0590
ABSORPTION	197983	197797	186	.0940
OUT/IN	.999951	.999948	.000003	.0003
FLUX*VOLUME	229804000	229685000	119000	.0518
RGT OUTFLOW	111866	113697	-1831	-1.6104
BOT OUTFLOW	210002	209494	508	.2425
TOP OUTFLOW	851.393	850.387	1.006	.1183
RGT NETFLOW	111866	113697	-1831	-1.6104
BOT NETFLOW	2261450	2261960	-510	.0225
TOP NETFLOW	851.393	850.387	1.006	.1183
TOT LEAKAGE	-2148730	-2147410	-1320	.0615
COLLISIONS	6418990	6414620	4370	.0681

ALL OF THE GROUPWISE BALANCE RESULTS WERE WITHIN 2 PERCENT AGREEMENT.

THE FLUX COEFFICIENT MATRIX RESULTS (PRINTED IN I BY J FORMAT) SHOW HIGHER RELATIVE DEVIATIONS FOR SOME OF THE SMALLER VALUES. A SAMPLING OF THESE RESULTS IS SHOWN BELOW.

I	J	BCS RESULTS	OAK RIDGE RESULTS	DEVIATION	PERCENT
8	2	37.7846	37.7652	.01940	.05
8	11	10.9565	10.9520	.00450	.04
13	6	7.99758	8.01535	-.01777	.22
15	15	.370734	.366654	.00408	1.11
11	33	.110189	.109652	.00054	.49
3	18	.039262	.043462	-.00420	-9.66
28	32	.000155	.000145	.00001	6.90
28	35	.0000138	.0000117	.000002	17.95

THE DEVIATIONS ARE CONSIDERED TO BE CAUSED BY THE MODIFIED ITERATION SEQUENCE, DIFFERENT SYSTEM LIBRARY ROUTINES, AND DIFFERENT ROUND OFF AND NORMALIZATION TECHNIQUES. THESE DIFFERENCES COMMONLY OCCUR BETWEEN MACHINES WITH DIFFERENT ARCHITECHTURE AND WORD LENGTHS.



Zone	Material	Required Convergence
1	Sodium	0.1
2	Steel	0.1
3	Steel	0.1
4	Void	0.1
5	Void	0.1
6	Void	0.1
7	Void	0.1
8	Concrete	-
9	Sodium	-
10	Steel	0.1
11	Steel	0.01
12	Void	0.01
13	Concrete	0.01
14	Concrete	0.1
15	Concrete	-
16	Concrete	-

Fig. 2. Void Streaming Geometry
(Zone numbers as shown on figure. Dimensions are in cm units)