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Subject: ***BWR Owners' Group Response to NRC Comments and Questions Regarding NEDO-32686 Revision 0, "Utility Resolution Guidance for ECCS Suction Strainer Blockage"***

Attachments: (1) BWR Owners' Group Response to NRC Comments and Questions Regarding the Utility Resolution Guidance for ECCS Suction Strainer Blockage
(2) Facsimile Transmittal, Mr. Tom Green from Michael L. Marshall,Jr., "Transmittal of NRC Staff's Initial Comments on URG", dated December 23, 1996

The BWR Owners' Group (BWROG) ECCS Suction Strainer Committee has prepared responses to the NRC initial comments and questions regarding the BWROG Utility Resolution Guidance (URG) for ECCS suction strainer blockage (see Attachment 1).

We believe that this supplementary information along with the preliminary plant specific alternate passive strainer design information previously transmitted to you on January 13, 1997 will support your ongoing efforts to complete the URG review in a timely manner. As you are aware, BWRs with fall '97 refueling and maintenance outages will require approval of the URG calculational methodology in order to minimize risks associated with their ongoing efforts to design and fabricate alternate passive strainers.. Installation of these strainers is expected to resolve the ECCS pump suction strainer plugging issue for the affected BWR plants.

Please note that the BWROG currently plans to amend the URG when all of the comments and questions are appropriately resolved, and the NRC has issued their Safety Evaluation Report (SER). At that time we will provide further clarifications to our members in accordance with the SER and issue an approved document package.

The attached response to initial NRC comments and questions has been prepared by the BWROG ECCS Suction Strainer Committee to support the NRC review of the URG and the related technical documentation. This letter should not be interpreted as a commitment of any individual member to a specific course of action. Each member must

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See attached distribution

formally endorse the BWROG position in order for that position to become the member's position.

If you have questions regarding this transmittal please contact the committee chairman, R. Sgarro (PP&L) at 610-774-7552, or the undersigned.

Very truly yours,

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Attachment 1

BWR Owners' Group Response to NRC Comments and Questions Regarding NEDO-32686 Revision 0, "Utility Resolution Guidance for ECCS Suction Strainer Blockage"

This document provides the BWROG response to the comments and questions of the NRC staff dated December 23, 1996 regarding the BWROG Utility Resolution Guidance (URG) document.

Suggested Solutions

The NRC staff provided three comments related to suggested solutions.

Comment 1

This comment expresses an NRC staff position that it is unwilling to consider scheduler extensions because a licensee requests a license amendment and encourages licensees to stay within their current licensing basis, if possible, in resolving this issue. Those licensees which do require a license amendment as part of the issue resolution should request them as early as possible.

BWROG Response

The BWROG agrees that licensees which anticipate that a license amendment will be necessary for the resolution option to be implemented should make their intentions known to the NRC staff as early as possible in order to facilitate the timely submittal and processing of the license amendment.

Comment 2

This comment is related to pipe break locations and is addressed in that section of the BWROG response.

Comment 3

This comment expresses an NRC staff concern that the URG counsels utilities to delay action, not even conducting 50.59 evaluations, until the NRC approves the URG.

BWROG Response

The BWROG addressed this comment during a meeting with the NRC staff held December 17,

1996. In summary, the section of the URG referred to by the staff comment encourages licensees to proceed with a *final* solution to the strainer blockage issue but cautions them that pursuit of *interim* solutions may identify an unreviewed safety question whose resolution may divert the resources of both NRC staff and the licensee, resulting in a delay in implementation of a final solution.

Pipe Break Locations

The NRC staff provided four comments related to pipe break locations.

Comment 1

The first comment is item 2 under the "Suggested Solutions" heading. This comment expresses an NRC staff concern that a utility may evaluate only a limited set of break locations (but enough to comply with 10 CFR 50.46), conduct partial replacement of insulation for those selected breaks, and then ignore other potential breaks where large volumes of fibrous insulation could be generated.

The BWROG response to this comment is incorporated in the response to Comment 2.

Comment 2

The second comment is item 1 under the "Pipe Break Locations" heading. This comment expresses an NRC staff concern that the NUREG-0800 Standard Review Plan (SRP) Section 3.6.2, and Branch Technical Position MEB 3-1 are not sufficient for meeting the requirements of 10 CFR 50.46 for the strainer clogging issue. The NRC staff believes that the pipe break locations identified in Regulatory Position 2.3.1.5 of Regulatory Guide 1.82, Revision 2 provide a more complete scope of breaks needed to meet the intent of 10 CFR 50.46.

BWROG Response

Based on the BWROG survey provided to the NRC staff on January 13, 1997, 11 of 24 BWR units responding to this survey anticipate using an MEB 3-1 approach in the selection of pipe break locations to be considered in the evaluation of debris generation. Other plants have licensing basis pipe break locations based on MEB 3-1 criteria but plan to use the guidance in the URG which provides a simplified analysis method (e.g., assume all fibrous insulation in the drywell is within the ZOI) to determine the amount of debris generated.

While the BWROG believes that SRP 3.6.2 and MEB 3-1 provide an acceptable means for identification of pipe break locations to be evaluated, the NRC staff should not infer that the evaluation approach provided in the URG is intended to "cherry pick" break locations to minimize the amount of debris generated. The URG clearly recommends that licensees consider

the break locations identified in Regulatory Position 2.3.1.5 of Regulatory Guide 1.82, Rev. 2 if these break locations have not already been evaluated. (An exception noted in the URG is pipe break locations described in Regulatory Position 2.3.1.5 (d) which is addressed in Comment 4).

It should also be noted that based on the BWROG survey previously referenced, only one plant is giving consideration to crediting pipe restraints in the evaluation of the zone of influence. Most plants intend to treat the breaks as unrestrained breaks producing double-ended jets. This will result in very large zones of influence. For example, an unrestrained break of a 28 inch recirc line (25.6 inch inside diameter) will result in a spherical zone of influence of approximately 44 ft. in diameter for unjacketed Nukon® insulation. These large zones of influence will assure that a conservative amount of debris will be input to the next step in strainer head loss evaluation. As discussed further in the response to Comment 2 under the Debris Generation section, another conservatism in the size of the zone of influence is that the URG methodology does not take into account the attenuation which would occur as the jet expands and interacts with piping, equipment and structures which fill the drywell.

The BWROG believes that SRP 3.6.2 and MEB 3-1 are sufficient for meeting the requirements of 10 CFR 50.46. The BWROG notes that SRP 3.6.2 identifies four specific areas reviewed by the NRC during the operating license stage. The fourth of these areas to be reviewed is described as:

> "The design adequacy of systems, components, and component supports to assure that the intended design functions will not be impaired to an unacceptable level of integrity or operability as a result of pipe whip *or jet impingement loadings*." (emphasis added) SRP 3.6.2, Rev. 1, July 1981.

The "Review Procedures" section of SRP 3.6.2 discusses the review criteria used by the NRC staff, including those related to jet impingement. It states, in part:

> "Analyses of jet impingement forces are reviewed. These analyses should show that jet impingement loadings on nearby safety-related structures, systems, and components will not be such as to impair or preclude essential functions."

The BWROG believes that the jet impingement loading on piping insulation and other materials in the drywell are within the scope of dynamic effects evaluated under SRP 3.6.2. Therefore, a plant with a licensing basis population of pipe break locations that are in accordance with the requirements of SRP 3.6.2 (which includes MEB 3-1 criteria) has already identified those breaks which are required to be evaluated. Imposition of selection criteria for pipe break locations different than used to identify the existing plant licensing basis pipe break locations would introduce regulatory inconsistency in the way pipe break locations are selected. Further, it is expected that a backfit analysis would be required prior to imposition of pipe break location selection criteria different than those embodied in the existing plant licensing basis. Performance of a backfit analysis would be inconsistent with the current NRC position that the strainer blockage issue is a compliance backfit.

Comment 3

The third comment is item 2 under the "Pipe Break Locations" heading. This comment expresses an NRC staff concern that the URG provides no guidance on how to evaluate pipe breaks inside the bio-shield wall or if it is necessary to do so.

BWROG Response

The reference to pipe break locations inside the bio-shield wall was made in the URG so that licensees did not inadvertently ignore the potential debris which may be generated from breaks inside the bio-shield. As can be seen from the utility responses to the BWROG survey, for most plants the insulation materials inside the bio-shield wall are not expected to be a major debris contributor. However, for those few plants which may have significant debris sources inside the bio-shield wall, a plant specific analysis is recommended to address debris generation inside the bio-shield. Because of the small number of plants affected and plant specific factors which would affect this analysis, the URG did not attempt to provide generic guidance on this issue.

Comment 4

The fourth comment is item 3 under the "Pipe Break Locations" heading. This comment expresses an NRC staff concern that the URG does not adequately address the pipe break selection criterion identified in Regulatory Position 2.3.1.5 (d) of Regulatory Guide 1.82, Rev. 2, i.e., medium and large breaks with the largest potential particulate debris to insulation ratios by weight.

BWROG Response

As discussed on URG pg. 28, lines 12 – 16, the criterion discussed in Regulatory Position 2.3.1.5 (d) of Regulatory Guide 1.82, Rev. 2 is associated with high head loss for low fiber loads. The BWROG has not observed the thin-bed effect on strainers of alternate geometry (e.g., star and stacked disc strainers.) In lieu of imposing another pipe break selection criteria which would apply to all plants, even those with strainer designs which have not been shown to be susceptible to the thin-bed effect, the URG provides alternate criteria for assuring that the thin-bed effect is appropriately addressed on those strainer designs which may be susceptible to the effect. This is discussed on URG pg. 118, lines 7 –19.

The BWROG has thoroughly tested the 60 point star strainer to evaluate the effect of thin fibrous beds in combination with large quantities of iron oxide sludge. Run number J21 (Appendix C of URG Reference 3; Tab 2, Volume I) sequentially determined the strainer head loss for fibrous loads over the range of 3 to 25 lbm. of Nukon when a constant 180 lbm. of iron oxide sludge was also present. This loading corresponds to a theoretical bed thickness of 0.086 to 0.71 inches for this 175 square foot strainer. For a flow rate of 5000 gpm the resulting head loss gradually

increased from 26 to 236 inches of water as the quantity of fiber was increased. There was no evidence of increasing head loss at lower fiber loads due to thin bed effects.

The stacked disk strainer #2 was also evaluated for potential thin bed effects. Run number P4 showed that there was no measurable head loss when the strainer was loaded with 3 lbm. of Nukon and 100 lbm. of iron oxide sludge. This loading represented a theoretical bed thickness of 0.089 inches for this 169 square foot strainer. When the quantity of Nukon was increased to 10 lbm. (Run number P8) the resulting head loss was only 33 inches of water at 5000 gpm. This represented a theoretical bed thickness of 0.30 inches. Note that for the 18 square foot truncated cone strainer tested by the BWROG very high head losses occurred when fiber loads were in the range of 0.5 to 3.0 lbm. and significant quantities of iron oxide sludge was present. These conditions represent a theoretical bed thickness of 0.28 to 0.83 inches.

As documented in Appendix I of URG Reference 3, the BWROG has concluded that star and stacked disk strainers have physical geometries that preclude the high head loss measured on flat surface strainers with minimal fiber and high corrosion product loads. This is because (1) star and stacked disk strainers have much larger strainer surface areas and lower fluid velocities for which head loss is directly proportional to velocity, and (2) these strainers do not collect fibers such that a uniform film can be formed.

Debris Generation

Comment 1

The NRC has questioned the calculation on page 36 of the URG which estimates the bulk dynamic pressure in the drywell from the downward flow of steam and air (or nitrogen if the containment is inerted).

BWROG Response

This calculation, for a typical Mark II containment, showed that the resulting dynamic pressure was two orders of magnitude below the destruction pressures of the most limiting insulation materials of interest. The table below summarizes the bases and bulk dynamic pressure calculation results for the three U.S. BWR containment types. Typical Mark I and III containments have higher calculated bulk dynamic pressures due to the smaller containment cross-sections. The Mark I calculation shown is for the grating elevation near the main steam line exit locations; the bulk dynamic pressures could be an order of magnitude higher in the upper drywell elevations (neck of containment).

These results confirm (even for upper elevations of Mark I containments) that properly installed and maintained insulation would not be susceptible to failure from the bulk dynamic pressure forces in any of the three BWR containment designs evaluated. Note 1 of URG Table 2 (page 47) cautions that "care should be exercised to assure that the critical characteristics of design for the material being evaluated (e.g., material of construction, method of attachment, methods of

construction including welds, latches, foil thickness, banding, etc., as appropriate) are representative of the materials tested". A similar caution on the use of appropriate attachment mechanisms is provided in Note 2 of URG Tables 4, 5, and 6. The BWROG believes the URG provides an appropriate level of guidance to utilities to assure that insulation is properly installed and that existing programmatic controls are adequate to assure proper maintenance.

Typical Bulk Dynamic Pressure (1)

Parameter	Mark I	Mark II	Mark III
Major Diam. (ft)	64 (2)	90	65
Minor Diam. (ft)	26 (2)	29	32
Total Area (ft^2)	2690 (2)	5700	2510
Estimated Porosity	0.6	0.8	0.7
Estimated Net Flow Area (ft^2)	1610	4560	1760
Max. Steam +Air/N_2 Flow (lbm./sec) (3)	12,800	14,700	15,600
Time of Max. Flow (sec) (3)	1.6	1.3	1.8
Containment Press. (psia) (3)	52.6	42.5	35.0
Steam + Air Density (lbm./ft^3)	0.12	0.10	0.08
Bulk Dynamic Press. (lbf./in^2)	**0.06**	**0.01**	**0.11**

note (1) basis is 28 inch double ended guillotine break
note (2) grating near main steam line exit location
note (3) GE power uprate calculations for representative BWRs

Comment 2

This comment expresses an NRC staff concern that the URG Zone of Influence (ZOI) section does not provide information on the debris size distribution for ZOI Methods 1 and 2. Further information is also requested on the application of Method 2 to a full size containment.

BWROG Response

The Zone of Influence section of the URG does not address debris size distribution for any of the four ZOI methods discussed. Information on the debris size distribution is contained in URG Section 3.2.3.2.1, "Debris Size Distribution" (page 70). The method used for the ZOI determination does not affect the "destruction factors" provided in Table 4 of the URG (page 71) as the destruction factors provided are material dependent. Of course for any given destruction factor, more material will be available for transport to the suppression pool for larger ZOIs. URG page 86, lines 10 – 16 provide guidance on how to apply the destruction/transport factors to the amount of material located within the calculated ZOI.

As to the question regarding application of Method 2 to a full size containment, it is important to note that Method 2 is based on the largest ZOI which would result from the fully separated, double-ended rupture of any pipe for the material of interest. The actual break location is not a consideration. The resulting spherical ZOI is then sequentially overlayed within all regions of the drywell to determine the most limiting quantities of debris.

In the Method 2 approach to overlaying the calculated ZOI sphere to encompass all regions of the drywell, a portion of the sphere may fall outside of the drywell. This may also occur when using the break location dependent ZOI Method 3. Those portions of the calculated ZOI which fall outside of the drywell are neglected in the analysis. The URG approach for calculation of the ZOI does not credit the expected attenuation of the jet emanating from a break which would occur as the jet expands and interacts with the piping, equipment and structures which fill the drywell. Should a pipe rupture occur in the drywell, this attenuating interaction is expected to result in an actual ZOI which is significantly smaller than the theoretical ZOI calculated via the URG methodology. As previously noted in the response to Comment 2 on pipe break locations, licensees intend to consider pipe breaks as unrestrained breaks which will result in large ZOIs and when considering that these large theoretical ZOIs will be applied at multiple break locations, there is confidence that a conservative amount of debris will be considered in the evaluation of the strainers.

Comment 3

This comment expresses an NRC staff concern that a larger break will generate a different debris distribution (i.e., more fines) than the distribution measured during the BWROG Air Jet Impact Testing (AJIT) program. The staff believes that the size of the nozzle in a debris generation experiment may affect the percentage of debris fines that are generated.

BWROG Response

A formal scaling analysis would show that the fines generated in a test where insulation is located at a downstream distance (x) from a nozzle of diameter D_B is a function of:

$$\% \text{ fines} = \text{function}\left(\frac{x}{D_B}, \frac{D_i}{D_B}, \ldots\right)$$

where D_i is the outer diameter of the insulation, which in this case was 18 inches. The nozzle size at CEESI (D_B = 3 inches) was fixed by the limited air supply volume so that the flow was choked at the nozzle. The more general question that could be asked is whether the tests which were run with $D_i/D_B = 6$ were representative with respect to the production of fines. The answer to this question is a qualified yes.

Fines are believed to be generated by jet interaction with insulation materials over time, as well as insulation interaction with the test vessel or containment prior to being transported to the wetwell (this is the insulation residence time). For BWROG containments, the residence time is of the order of seconds. This is obtained by dividing the drywell airspace volume by the volumetric flow from the break . CEESI air jet impact tests had blowdown durations of five or more seconds.

The production of fines by the direct impact of the jet with the insulation occurs when the insulation is close to the break with the jet immersing the insulation. The initiation of the jet flow immediately breaks the cassette or insulation blanket away from the pipe and accelerates the essentially intact cassette or blanket away from the break. The interaction time of the insulation in the jet is short and very few fines are produced. When the cassette or blanket is located further from the break, a smaller fraction of the momentum forces of the jet intersect the cassette or blanket, and the insulation does not instantaneously break free from the pipe. The jet flow structurally weakens the cassette or blanket as it undergoes mechanical failure until the insulation is sufficiently weakened, and no longer remains intact on the piping. The insulation is eventually released and is accelerated away from the pipe. For this case, the interaction time of the insulation in the jet is longer, and fines are most likely produced prior to the release from the pipe as well as during acceleration. This scenario is believed to result in the maximum amount of fines. It should be further noted that from ANSI Standard 58.2, the jet will expand to an asymptotic diameter of about 6.5 break diameters in about 3 break diameters downstream. Therefore, CEESI tests conducted at 5 break diameters downstream of the nozzle have insulation cassettes or blankets which are being impacted by a major fraction of the jet momentum.

From the above evaluation, it is concluded that the percentage of fines generated will not be greater for larger pipe breaks since the interaction time in the jet will be shorter due to the higher integrated forces over the insulation cassette or blanket. The BWROG position is that the percent fines measured at CEESI is typical and possibly conservative with respect to that expected from medium to large pipe breaks of interest.

Comment 4

This comment expresses an NRC staff concern that it is unclear how the debris on the ruptured pipe is included in the estimation of fine debris. The staff also commented that the BWROG has previously conceded that insulation located on the break will be destructed into fines.

BWROG Response

The BWROG has not conceded that the insulation on the break will be destructed into fines, but has agreed to assume that the insulation in the zone of influence between the break and approximately three diameters from the break is 100% fines. This conservative assumption was adopted because tests were not conducted at CEESI where the insulation material was placed directly on the break.

The debris generated on the ruptured pipe is taken to be fines by setting $\eta_B = 0$ for $x \leq x_a$ where x_a is approximately 3 break diameters as described in URG Reference 5, page E-3 (URG Technical Support Documentation, Volume 2, Tab 2, Appendix E). Therefore, with the computation of $\bar{\eta}_B$, which is the average fraction of blanket material with low transport efficiency in the zone of influence, the fines produced in the vicinity of the break are reflected in the computed value $\bar{\eta}_B$ (see the Table on page E-3).

Comment 5

This comment expresses an NRC staff concern that debris distribution should in part be a function of distance from the break. When comparing the data on different debris sizes produced from the BWROG AJIT test, it was noted by the NRC staff that the tests where the target was closest to the nozzle did not increase the percentage of the smaller debris sizes.

BWROG Response

The BWROG interpretation as to why less fines are produced nearer to the break was given in response to Comment 3 above. To reiterate, the BWROG believes that when the insulation is installed very close to the break so that a major fraction of the momentum flux of the jet is intersected by the insulation target, the insulation is immediately released from the pipe and accelerates away from the break with relatively little production of fines. Maximum fine production would occur at a downstream distance where the jet momentum intersected by the insulation was marginally able to break the cassette or blanket from the piping. Here the insulation would have a maximum interaction time in the jet to undergo erosion and other mechanisms that produce fines.

Comment 6

This comment expresses an NRC staff concern that a more quantitative description of fibrous debris size should be included in the URG.

BWROG Response

The discussion of debris sizes in the URG is based on the debris characterization provided in the report on the BWROG sponsored Air Jet Impact Testing (URG Reference 6.) The AJIT report separately characterizes RMI debris and fibrous debris. As noted in NUREG/CR-6224, prior research had been done by others to quantitatively characterize fibrous debris sizes and it was not the intent of the BWROG to repeat this previous work. The intent of the BWROG debris characterization was to group debris into classifications appropriate for use in evaluation of drywell transport.

When collecting debris after each fibrous AJIT test, the debris was identified as being in one of the following three categories:

- fines, small fibers, and dust
- large fiber pieces
- blankets and covering material

A size approximately equal to the size of the hand was used to differentiate between small fibers and large fiber pieces. This provided the personnel collecting the debris with a ready reference size to use when categorizing the debris. After each test, the large fiber pieces, intact blankets and pieces with covering material was collected first. The remaining material (fines, small fibers, and dust) was then collected.

The URG states that pieces greater than hand-size are considered as large fiber pieces. See URG page 73, line 8.

Comment 7

This comment expresses an NRC staff concern that a statement in URG Reference 21 (page 28, 2nd paragraph, last line). The statement under question is that the amount of unqualified coating expected to fail in the early stages of a LOCA is small compared to the amount of qualified coatings that would fail from direct impingement of the jet. The staff also expressed a concern that pictures in NUREG-0897, Revision 1 show walls that are distant from the test location being stripped of wall paint which appears to be inconsistent with URG Reference 21.

BWROG Response

The BWROG believes that the statement in Reference 21 that the amount of debris generated

from unqualified coatings in the early stages of a LOCA is expected to be small compared to the amount of coatings removed by direct impingement is correct. As discussed in Section 2.8 of Reference 21 (pages 18 - 19), the failure of unqualified coating would not be expected to occur until after several hours or more of exposure to LOCA conditions which are needed to cause a pressure differential across the coating. Only after a pressure differential is formed which is then followed by an abrupt decrease in drywell pressure is there a likelihood that an unqualified coating could disbond from the surface. This build-up of a pressure differential across the coating which is then followed by an abrupt decrease in drywell pressure is not expected to occur in the early stages of a LOCA. Therefore the amount of debris expected from direct jet impingement in the early stage of a LOCA is greater than the amount of debris expected from failure of unqualified coatings (not directly impacted by the jet) early in a LOCA.

The BWROG believes that the photographic evidence from the HDR tests reported in NUREG-0897, Revision 1 support the information in URG Reference 21 as to the failure mechanism of unqualified coatings. The HDR facility was built in the early 1970s and the first blowdown test was conducted there in 1977. Although the exact composition and method of application for coatings employed in the HDR facility are not provided in NUREG-0897, it would be reasonable to conclude that given the timeframe on when the HDR was built that these coatings would fall into the "unqualified" category as currently used at US BWRs. Given that multiple blowdown tests were run at the HDR facility, the failure of unqualified coatings would be expected after exposure to LOCA conditions.

It should also be noted that without additional information beyond that provided in NUREG-0897 on the exact HDR test sequences, the location of the stripped coatings relative to the break location, and the relationship between the photographs and the test sequences; some uncertainty exists as to whether the stripped coatings shown in the photographs were in fact removed by direct impingement of a LOCA jet or whether it is the result of the failure of an unqualified coating.

Comment 8

The NRC has questioned the statement that insulation removal occurs when the fluid stagnation pressure exceeds a certain value, "which has been shown to typically range from several psi to about 50 psi for fibrous insulation materials".

BWROG Response

Table 2 of the URG (page 46) summarizes the destruction pressures for various insulation materials tested by the BWROG at CEESI. For insulation materials other than reflective metal, the destruction pressures range from 4 psi (for Min-K) to 40 psi (for K-Wool). The destruction pressures for the more common fibrous insulation (Nukon, Knaupf, and Temp-Mat) range from 10 to 17 psi.

Drywell Transport

Comment 1

This comment expresses an NRC staff question on how the transport fractions for materials other than Nukon and RMI were determined.

BWROG Response

As noted on URG page 75, lines 14 – 18, the BWROG believes that the transport test results reported in Reference 5 for fine Nukon insulation are sufficiently conservative to account for any minor variations in transport efficiency that may occur for other types of fibrous insulation. Therefore, the same transport fractions are used for all fibrous insulation materials addressed in the URG.

However, because of their non-fibrous nature, the BWROG does not believe it is appropriate to apply the transport fractions for fibrous materials to calcium silicate, Koolphen-K or Min-K insulation materials unless supported by test or further analysis. For these material types, the URG assumes a transport fraction of 1.0 for the fines and other small debris pieces for all US BWR containment designs.

Comment 2

This comment expresses an NRC staff question on how the results shown in Figure 1 in Appendix E of URG Reference 5 are adjusted for a ZOI that is smaller than 100D.

BWROG Response

Questions regarding the application of the curve relating percent large fibrous debris as a function of distance from the pipe break (URG Reference 5 in Technical Support Documentation Volume 2, Tab 2, Page E-2) were resolved during the meeting with the NRC on December 17, 1996. The percent large fibrous debris (y-axis parameter) is determined using this graphical correlation after the equivalent spherical diameter of the zone of influence (x-axis parameter) is calculated.

There is a substantial amount of data for Nukon from the BWROG sponsored air jet test program which demonstrates how the generation of material with low transport efficiency varies as a function of insulation target distance from the test nozzle. The linearized model provides a reasonable fit to the data and all other insulation materials should follow a similar trend. Furthermore, for all materials there is a distance from the break for which the material is not destructed (η_B equals 100 percent) as was demonstrated by the Nukon data. This provides an additional data point to provide a best estimate of the linearized fit. It is our opinion that running additional tests for the other insulation materials will not significantly change the estimated

values for the average fraction of blanket material with low transport efficiency that are presented in the Technical Support Documentation, Volume 2, Tab 2, Appendix E, page E-3.

NPSH Calculations

Comment 1

The NRC staff expressed a concern with the description of the possibility of operation at reduced ECCS flow rates provided in the URG on page 121, lines 14 through 19, and on page 124, lines 22 through 24. These sections discuss the possibility of reducing ECCS flow rates later in the LOCA event, at times when suppression pool temperatures are maximum. Reduction in ECCS flow at this time would result in an increase in NPSH margin.

The NRC staff's concern is that it was not clear how reduced ECCS flows would be modeled in the LOCA analysis, and the approach described in the URG did not appear conservative.

BWROG Response

The URG does not recommend any reduction in ECCS flows below values required by the LOCA analysis. Rather, the intent of the discussion on page 121 lines 14 through 19 and on page 124 lines 22 through 24 is to ensure that any reduction in ECCS flow which is credited in the NPSH calculation is consistent with the flow assumptions in the current licensing basis LOCA analysis.

Two possibilities for ECCS flow reduction without reducing flow below the values credited in the LOCA analysis have been identified by the BWROG.

First, the design basis value for ECCS flow in the LOCA analysis is typically lower than the actual pump capability. In some cases, the pump capability exceeds the LOCA requirement by a substantial margin. In these cases, actual ECCS flows could be reduced while still maintaining flow rates equal to or above those assumed in the licensing basis LOCA analysis. This may be of particular value for plants with a ring header ECCS suction line configuration.

Secondly, once reactor pressure vessel level is recovered following completion of the reflood stage (typically in the first few minutes of the event), the LOCA transient is over from a fuel integrity standpoint. ECCS flow rate assumptions are a key input to this early phase of the transient, as they have a direct impact on the time to reflood, the predicted peak fuel clad temperatures and fuel failure predictions. Following recovery of reactor pressure vessel level, current EOPs allow the operators to reduce ECCS flow to that required to maintain RPV level in a normal range. Since the maximum debris loading on the strainers and maximum suppression pool temperatures are not achieved until significantly after the reflood is complete, it is acceptable to calculate NPSH margins at reduced ECCS flow rates required to provide RPV makeup and adequate suppression pool cooling.

The intent of the URG guidance is to ensure that, if this approach is used, (1) operating procedures and operator training are adequate to ensure actions to reduce flow are taken when required to protect ECCS pump NPSH margins and (2) that the ECCS flow rates remain consistent with the assumptions in the licensing basis LOCA analysis.

Comment 2

The NRC staff is concerned that the guidance provided in URG Section 3.2.6.3 on pages 122 and 123 regarding selection of suppression pool temperatures for NPSH calculations is inconsistent, and does not require use of the maximum value stated in the Tech Specs or FSAR.

BWROG Response

The intent of paragraph 3 (a) on page 123 of the URG is to require use of the current licensing basis maximum suppression pool temperatures in calculation of NPSH margins, where these values are specifically identified in the current licensing basis. The intent of paragraphs 3 (b) on page 123 and paragraph 3 (c) on page 124 is to provide guidance on calculation of maximum suppression pool temperatures where these values are not specifically identified in the current licensing basis, or when a licensing basis change is being considered.

In addition, the BWROG recognized that the change in the design basis for the ECCS suction strainer from an assumed 50% strainer blockage to calculation of actual head losses with debris beds fully covering the strainer makes it necessary to consider operation at low suppression pool temperatures as well as high suppression pool temperatures to ensure a conservative design. Reference 31 of the URG discusses the competing effects of viscosity and vapor pressure as a function of temperature. Basically, head losses at the strainer increase with decreasing temperature due to increased viscosity, while vapor pressure related head losses decrease with decreasing temperature. Due to these competing effects, it is necessary to evaluate a range of suppression pool temperatures from a low design basis value to a high design basis value to determine which case results in minimum NPSH margin.

The intent of paragraph 1 (c) on page 123 is to provide guidance indicating the need to consider both high and low suppression pool temperatures in the ECCS suction strainer NPSH calculations.

Comment 3

The NRC staff expressed a position that it is unwilling to consider license amendments to provide credit for containment pressure to plants who do not already have it approved. The staff is also unwilling to consider increases in the amount of pressure credited for plants which were licensed with credit for containment pressure.

BWROG Response

As stated on URG page 120, lines 14 – 15, the URG recommends that plants with a current licensing basis which does not allow credit for containment pressure should not pursue a change to the licensing basis to allow such credit. Further, as noted on page 120, lines 8 – 12, the BWROG recommends that plants whose licensing basis allows credit for containment pressure should consider, if practicable, use of a strainer that results in acceptable ECCS pump NPSH without reliance on containment pressure.

<u>Comment 4</u>

The NRC staff expressed a concern that the URG should explicitly discuss or describe the criteria that need to be satisfied in order to ensure that BWROG head loss data is properly applied to other strainer designs.

BWROG Response

Strictly speaking, the BWROG data for truncated cone strainers, stacked disk strainers, and star strainers should only be applied to designs that are geometrically similar to strainers which have been tested. Geometrically similar strainers are those which have all dimensions scaled up or down by a constant factor. This criteria cannot be met exactly for stacked disk strainers since the distance between disks is maintained to allow fiber to enter the space between disks. Geometrical scaling of 60 point star strainers will result in a 60 point star strainer with identical angles at the peaks and valleys. This geometrical scaling does not apply to hole size of the perforated plate used to build strainers, since this hole size is chosen to restrict debris from entering the ECCS suction lines (the perforated plate has an insignificant affect on the total strainer head loss).

<u>Comment 5</u>

The NRC staff expressed a concern that some of the calculated bump-up factors determined from Equation 6-8 of Reference 2 (see Appendix A) may not be conservative with respect to actual head loss data obtained at EPRI.

BWROG Response

The bump up factors calculated with equation 6-8 were compared with data obtained in the BWROG alternate strainer test program. The bump-up factor calculation was developed to provide conservative results. The calculations shown in Table 6-1b in the Alternate Strainer Report (Reference 2, Technical Support Documentation, Volume 1, Tab 2, page 55) indicate that the calculations are conservative for all the test cases.

The results from these calculations are shown below:

No Recipe Run	No Recipe Head Loss (inches of H_2O)	Recipe Run	% Recipe (%)	K_{bu}	Measured Head Loss (inches of H_2O)	Predicted Head loss (inches of H_2O)
J4	74	J6	25	3.19	234	236
J8	130	J11	25	1.60	150	208
J8	130	J11	50	2.21	215	287
J27	203	J28R	100	1.26	238	256
J22	74	J23	100	2.25	160	167

These calculations show that the predicted head loss is always greater than the measured value of head loss. The calculations were performed following the procedure outlined in the Alternate Strainer Report which requires that when the M_c/M_f ratio is greater than 4, this ratio is set equal to 4 to compute the bump-up factor.

The uncertainty associated with the measurements has been documented in the Alternate Strainer Test Report (Technical Support Documentation, Volume 1, Tab 2, Appendix H). However, the effect of the uncertainty in the measurements and the data repeatability has not been used to quantify the uncertainty or confidence associated with equation 6-8 which predicts head loss.

URG Overall

Comment 1

The NRC staff expressed an opinion that because of the many different options available to a licensee provided in the URG that their resources may be better utilized reviewing detailed plant specific responses than in review of the URG.

BWROG Response

The BWROG acknowledges that the URG provides flexibility for licensees to evaluate and resolve the strainer blockage issue. This flexibility was necessarily included in the URG to accommodate the variations among plant designs and licensing basis that exist among the BWRs and to avoid a prescriptive approach to resolution that would introduce unjustified costs or operational constraints. While the URG does offer flexibility in resolution of the issue, the BWROG is confident that a licensee which follows the guidance in the URG will implement a resolution to the strainer blockage issue which will assure that the NPSH available to the ECCS pumps is conservatively adequate to meet their design basis requirements.

As agreed during the December 17, 1996 meeting with the NRC staff, in order to provide

additional information to the NRC on which options of the URG licensees planned to use; the BWROG conducted a survey to identify utility intentions on how they plan to address each of the key alternate design methodologies documented in the URG. The results of the BWROG survey were provided to the staff on January 13, 1997. It is expected that the survey results will assist the NRC staff in their evaluation of the URG.

The BWROG believes that the responsibilities of the NRC and the interests of licensees will best be served by the generic approval of the URG. As noted in the BWROG survey, there are many areas where licensees are relying on NRC acceptance on the methodologies provided in the URG (e.g., zone of influence, debris generation, transport, etc.). Should the NRC decide to pursue plant specific reviews in lieu of a generic approval of the URG, there will be a large increase in the workload for both the NRC staff and the individual licensees to obtain NRC approval on a plant specific basis. Pursuit of these issues on a plant specific basis will further challenge the already difficult resolution schedule.

Comment 2

The NRC staff expressed a comment that it needs to have a firm and clear understanding of the words bound (including bounding) and conservative as used in the URG.

BWROG Response

The terms "bound" or "bounding" are commonly used to describe conditions where the value used in the analysis clearly equals or exceeds any physically possible value for the parameter of interest. The term "conservative" is commonly used to indicate instances where the value used in the analysis provides some amount of margin above the best estimate value.

The commonly accepted usage of the terms "bound" and "conservative" was not strictly adhered to in the URG text. Use of the phrases "bound" and "bounding" in the URG should generally be interpreted as "conservative" except in the following instances:

1. ZOI Method 1 is clearly a bounding method for calculating the amount of material which may be subject to destruction;
2. a transport fraction of 1.0 applied to various debris species is bounding;
3. the assumption that 100% of the fibrous material inside 3 pipe diameters from the break is destructed into fines and small fibers (i.e., transportable) is bounding.

Except as noted above, as used in the URG the terms conservative and bounding in effect mean the same thing, i.e., conservative.

Attachment 2

United States Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Division of Engineering Technology
Generic Safety Issues Branch

FACSIMILE SHEET

DATE: December 23, 1996

TO: Mr. Tom Green, Senior Technical Project Manager
General Electric
Fax #: 408-925-2476 Phone #: 408-925-1308

FROM: Michael L. Marshall, Jr., Task Manger
U.S. Nuclear Regulatory Commission
Fax #: 301-415-5062 Phone #: 301-415-5895

Number of Pages (excluding cover sheet): 7

SUBJECT: TRANSMITTAL OF NRC STAFF'S INITIAL COMMENTS ON URG

The attached list of comments is not a complete or final list of staff comments on the URG. Also, none of the comments should be construed as an official NRC position regarding the BWR suction strainer debris blockage issue or any other issue. The purpose of the list is to document the most significant comments by the staff on the URG. The staff originally presented these comments during the 12/17/96 public meeting with the BWROG. If you have nay questions regarding these comments please contact R. Elliott or M. Marshall.

☺☺

Initial Staff's Comments and Questions on URG

Suggested Solutions

1. Throughout the URG, there is a great deal of references and discussion on several different potential licensing basis changes a utility may wish to pursue in determining a resolution to the BWR Strainer Clogging issue. The staff position on these types of amendment requests is that it is unwilling to consider scheduler extensions because a licensee decides to request a license amendment. The staff strongly encourages licensees to develop a resolution that stays within their current licensing basis, if possible. If a utility needs a license amendment in order to complete its resolution of the issue, then it should get such requests to the staff as early as possible in order to facilitate a timely turnaround by the staff, and it should factor the staff review time into its schedule.

2. Page 22, Section 3.1.3.4.7, "Partial Replacement of Fibrous Insulation with RMI:" This section requires substantially more detail in order for the staff to understand how a licensee would utilize this potential solution/partial solution. In addition, there is no guidance for the utility to follow. The staff is concerned that utility may only evaluate a limited set of potential break locations (but enough to comply with 10 CFR 50.46), conduct partial replacement of insulation for those selected breaks, and then ignore other potential breaks where large volumes of fibrous insulation could be generated.

3. Page 16, Section 3.1.3, "Plants With Significant Amounts of Fibrous Insulation," Last Paragraph (continues on Page 17): What is the purpose of this paragraph? It seemingly counsels utilities to take no action (not even conducting their 50.59 evaluations) until the NRC approves the URG. Licensees should be doing as much as they can during the time the staff is reviewing this document, especially their 50.59 evaluations.

Pipe Break Locations

1. Page 27, Section 3.2.1.1, "Pipe Break Locations:" The staff's position on the use of SRP Section 3.6.2 is misrepresented on this page. The staff points out that NUREG 0897 summarizes the staff's <u>technical</u> findings relative to the resolution of USI A-43. It does not constitute a <u>regulatory</u> position. The forward to NUREG 0897 on page xiii states that "It should also be clearly noted that this report is not a substitute for requirements set forth in General Design Criteria 16, 35, 36, 38, 40, and 50 in Appendix A of Title 10 of the Code of Federal Regulations Part 50, nor is it a substitute for guidelines set forth in NRC's Standard Review Plan (SRP, NUREG-0800), Regulatory Guides, or other regulatory directives."

   As pointed out to the BWROG in the staff's letter to R. Sgarro dated July 25, 1996, "10CFR50.46 states in part, that ECCS cooling performance "must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated." There is no language in the rule that implies only the most probable break locations need to be evaluated." The staff goes on to say that while SRP Section 3.6.2 "may be a good starting point from which to start an analysis, it does not by itself appear to be sufficient to meet the intent of the rule. The Standard Review Plan

(SRP), Section 3.6.2 and Branch Technical Position (BTP) MEB 3-1 was developed for looking at dynamic and environmental effects of an LOCA (e.g., pipe whip), and are not considered sufficient for meeting the requirements of 10CFR50.46 for the ECCS suction strainer clogging issue.
SRP Sections 6.3 and 15.6.5 deal with evaluation of the ECCS, and more specifically, the adequacy of ECCS performance. The review procedure of 15.6.5 specifically requires reviewers to ensure that "A variety of break locations and the complete spectrum of break sizes were analyzed." This is clearly the intent of 10CFR50.46. Regulatory Guide 1.82, Revision 2 (RG 1.82) Regulatory Position 2.3.1.5 states the following: "As a minimum, the following postulated break locations should be considered. (a) Breaks on the main steam, feedwater, and recirculation lines with the largest amount of potential debris within the expected zone of influence, (b) Large breaks with two or more different types of debris within the expected zone of influence, (c) Breaks in areas with the most direct path between the drywell and wetwell, and (d) Medium and large breaks with the largest potential particulate debris to insulation ratios by weight." The staff believes that the RG provides a more complete scope of breaks needed to meet the intent of 10CFR50.46."

The staff also points out that neither SRP Section 3.6.2 nor BTP 3-1 references 10 CFR 50.46, or in anyway discusses compliance with that rule.

2. Page 32: The URG provides no guidance on how to evaluate pipe breaks inside the bio-shield wall. It's not even clear if they consider it necessary to do so. When the URG leaves it up to an individual utility to decide if, or how, to perform some part of the analysis, it is impossible for the staff to draw any conclusions as to the adequacy of the proposed methodology.

3. URG 3.2.1.1 embodies guidance found in RG 2.3.1.1, but not all guidance found in RG 2.3.1.5 - "Medium and large breaks with the largest potential particulate debris to insulation ratios by weight." Even though the URG did mention this break location criterion, in the section that gives clear directions, this criterion seems to be neglected. The staff is aware of the BWROG claim that the above criterion is not a problem for alternate strainers, but the URG does not limit itself to providing guidance for alternate strainers.

Debris Generation

1. Page 36, Section 3.2.1.2, "Zone of Influence:" What is the basis for the calculation shown and its applicability to all containments? It appears that the inputs for M and A for a Mark II are incorrect. The staff is concerned that this calculation underestimates bulk dynamic pressure.

2. Pages 37 and 38, Sections 3.2.1.2.3.1 and 3.2.1.2.3.2, Methods 1 and 2 for calculating Zone of Influence: These methods provide no information on size distribution of debris, so it is not clear what the basis is for not assuming 100% transport to the suppression pool. Also, please explain how Method 2 will applied to a full size containment?

3. It is not clear if/how the CEESI AIJT tests were scaled to represent larger pipe breaks. The staff is concerned that a larger break will generate a different debris distribution (i.e., more fines) than the distribution measured during the AIJT program.
The staff believes that the size of the nozzle in a debris generation experiment may affect the percentage of debris fines that are generated. Consequently, a large break is likely to generate a higher percentage of fines than a smaller break which could substantially impact the amount of debris transported. The BWROG data is developed based on one nozzle size. What is the basis for scaling that to a large break in a plant?

4. During past meeting with the staff, the BWROC as conceded that the insulation on the break will be destructed into fines. If is not clear from the debris generation section how the debris on the ruptured pipe is included in the estimation of fine debris.

5. Debris generation (specifically debris distribution) should in part be a function of distance from the break. While comparing the category 1, 2, and 3 debris classes by distance from the break, the staff discovered that fewer fines (by mass) were generated in tests where the target was closer to the break than in tests where the target was located further from the break (see attached figure). These results appear to be counter intuitive. One would expect more fine debris closer to the break. How did the BWROG explain these results? Were all the tests valid?

6. Because the words used to described debris size are subjective (e.g., fine, shred, large, etc.) a more quantitative description should be included in the body of the URG. For instance in NUREG/CR-6224 fine fibrous debris is classified as Class 1 which is small single strand of fiber glass, but the URG characterizes fines as Category 1 which is fibrous debris that is smaller than an adult male open hand (this definition is not explicitly stated in the URG).

7. The conclusion that: "The amount of debris that might be generated by unqualified coatings that are close to a line break location is expected to be small compared to the bounding estimates for the jet impingement debris" runs contrary to the failure of unqualified coatings made on page 28 of 33 and is not supported by information in this section. Examination of HDR post-blowdown pictures in Appendix C of NUREG/0897 Rev. 1 (e.g., Figures C-4 and C-5) which show walls in compartments distant from the jet nozzle chamber stripped of wall paint do not support this conclusion.

8. The abstract notes that insulation removal has been shown when the fluid stagnation pressure exceeds a certain value, "which has been shown to typically range from several psi to about 50 psi for fibrous insulation materials." From my review of the CEESI experiments in the URG supporting Volume II, I find this statement misleading. Severe destruction of unjacketed fibrous insulation targets occurred at stagnation pressures on the order of 12 to 20 psig. This statement is also not supported by the values set forth in Table 2, page 39 of the draft URG.

<u>Drywell Transport</u>

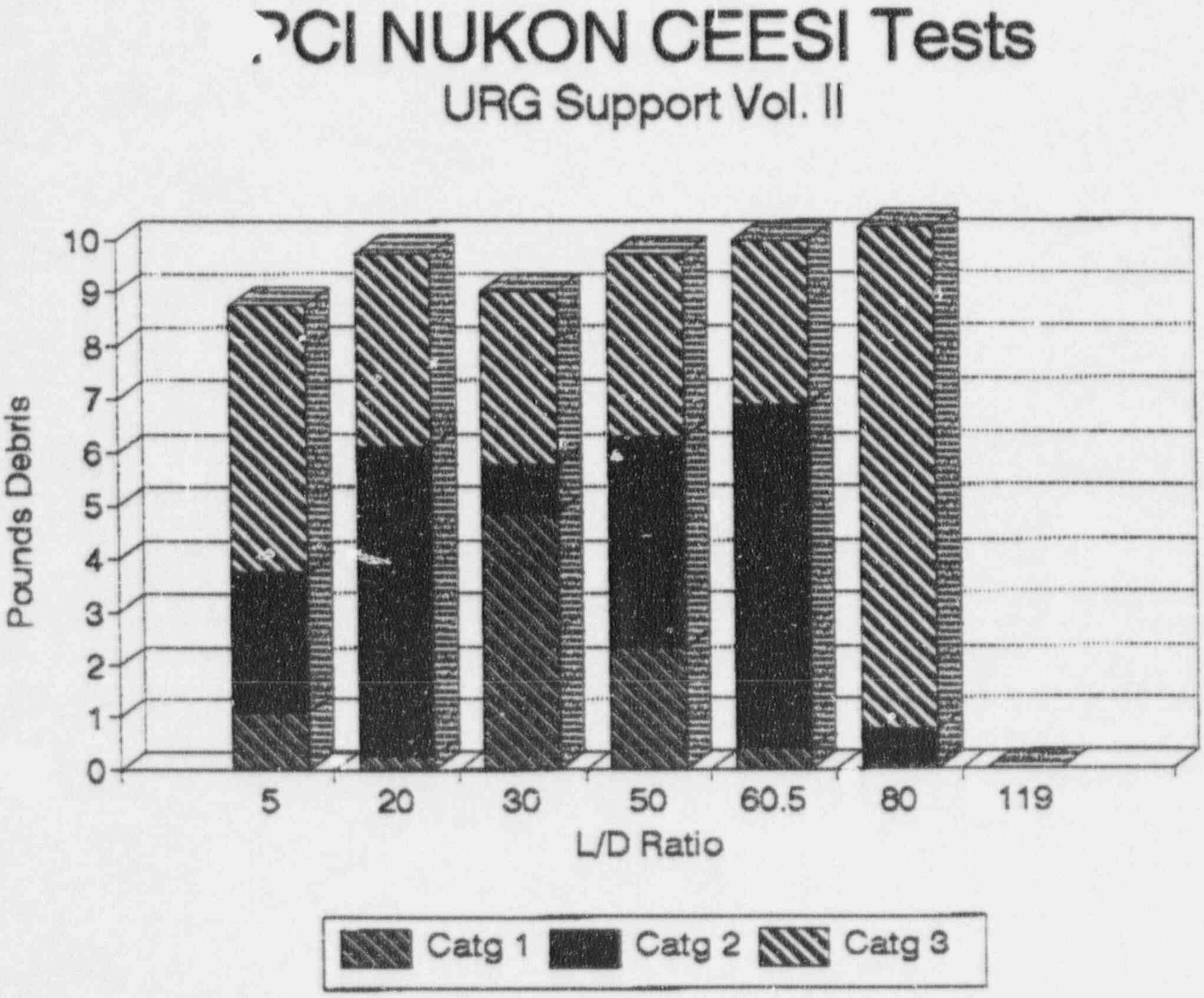
?CI NUKON CEESI Tests
URG Support Vol. II
Pounds Debris
10
9
8
7
6
5
4
3
2
1
0
5
20
30
50
60.5
80
119
L/D Ratio
Catg 1
Catg 2
Catg 3

Figure 2

1. The staff is interested in how transportability (i.e., transport fractions) of materials other NUKON and RMI was determined. The tests at CDI seem to focus on NUKON and RMI. The staff is interested in knowing if enough data was collected during the BWROG test program to access the transportability of materials other than NUKON and RMI.

2. How should/are results shown in Figure F1 in Volume II, Tab 2 on Page E-2 adjusted for ZOI that are smaller than 100D. The staff is concerned that transportable debris will be under predicted if these results are not adjusted for smaller ZOI.

<u>NPSH Calculations</u>

1. Page 121 lines 14 through 19 states, "it may be acceptable to evaluate NPSH at reduced ECCS flows during the period of peak temperature, reducing the head losses at the strainer and again increasing NPSH available. If the NPSH analysis credits reduced ECCS flow through the strainers in order to meet pump NPSH requirements, appropriate operating and emergency procedures should be in place and operator training conducted so there is assurance that the operators will reduce pump flow at the appropriate point in the accident progression."

   Additionally, page 124 lines 22 through 24 states that "care should be taken to ensure that changes in ECCS flow rates are consistent with the inputs and assumptions used in the evaluation model required by 10CFR 50.46 to calculate the ECCS cooling performance."

   The staff is not aware of any licensing basis that credits reduced ECCS flow to meet NPSH requirements. If this is the case, it is not clear to the staff how reduced flows would be modeled in the LOCA analysis. LOCA methodology generally requires the input of ECCS design flows. This approach does not appear to be conservative.

2. On page 122 in the BWROG Guidance section, step one states that the "calculation of pump inlet conditions should follow the methodology described in Section 3.2.3 of NUREG-0897, Revision 1 with the following exceptions:

   c) the methodology provided in Reference 31 should be used to determine the temperature of the pumped fluid used in the calculation of NPSH available to the ECCS pumps."

   Then on page 123, step 3 states "the range of expected temperatures of the pumped fluid should be considered when evaluating the NPSH available to the ECCS pumps. In making a determination of the range of expected fluid temperatures, the following should be considered:

   a) the plant licensing basis may specify the maximum expected fluid temperature. If specified in the licensing basis, this value should be used unless the plant licensing basis is changed.

   b) the maximum fluid temperature may be calculated using industry accepted analytical

tools such as Contempt, GOTHIC, Contain, etc."

There does not appear to be any consistency in the guidance as to which maximum temperature should be used in the NPSH available calculation, i.e., the Reference 31 value, the tech spec value, or the value calculated by the analytical tools. The maximum value stated in the tech specs or FSAR should be used in the NPSH calculated unless the plant licensing basis is changed.

3. The staff is unwilling to consider license amendments to provide credit for containment pressure to plants who do not already have it approved. In addition, the staff is unwilling to consider increases in the amount of pressure credited for plants who were licensed with credit for containment pressure. Since the issuance of RG 1.1, the staff has been unwilling to consider such requests, and is still reticent to do so.

4. In the URG, it is stated that the head loss data collected by the BWROG is applicable to other strainer designs. The URG should explicitly discuss or describe the criteria that need to be satisfied in order to ensure that data is properly applied.

5. The staff and its contractor are currently in the process of compare values calculated with equations 6-8 (with bump-up factors) with the data collected during the BWROG's alternate strainer test program (i.e., EPRI tests). When the calculated values were compared to four of the tests, three of the measured values were higher than the calculated value (by as much as 25%). Considering the NPSH margin that some plants have a 25% difference could be significant. Are there any conditions that cannot be attributed solely to curve fitting were equation 6-8 consistently under predicts head loss that the staff should be made aware? Has the BWROG attempted to quantify the uncertainty/confidenceassociated with equation 6-8?

URG Overall

1. The URG does not appear to provide a specific methodology for analyzing a plant. Rather, it chooses to provide many different options which licensees can pick and choose at their discretion. The fact that the BWROG "does not recommend" a certain option does not stop a utility from using it. Many of the options are sufficiently ambiguous as to allow multiple interpretations. The acceptability of any particular calculation cannot be judged on its own. It must be evaluated as an entire analysis. A calculation of one aspect of an analysis may be conservative, but that does not mean that the whole analysis will be conservative. For instance, to assume 100% of the fiber in containment is generated as debris may be conservative. But if only a minute fraction of that debris is considered as being transported to the suppression pool, the entire analysis may end up non-conservative. In other words, the URG does not provide any assurance that a utility will follow a specific combination of options which will lead to a reasonable or conservative analysis (i.e., solution).

The staff is of the opinion that our resources would be better used in reviewing detailed plant specific responses because the URG allows so many variations that we will be

compelled to perform detailed reviews or audits of plant specific fixes. A licensee committing to perform its analysis in accordance with the URG has not provided the staff with sufficient information on which to determine the acceptability of their response.

2. The words bound (incl. bounding) and conservative should be clearly defined in the URG, because the definitions of these words tend to be subjective. The staff needs to have a firm and clear understanding of their usage.

SPECIAL HANDLING

DATE: 2/13

ATTENTION: DRP
Encoding
QC/QA
Other

FROM: JC RFLC

COMMENTS: Pls. Expedite processing. Thx

▸ Return this sheet & the document to RFLC after assigning the ANO. The ANO needs to called in to the NRC DCD.

▸ Other:

(DO NOT FILM THIS SHEET WITH THE DOCUMENT)