Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

May 22, 2014
NOC-AE-14003103
10 CFR 50.12
10 CFR 50.90

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
First Set of Responses to April, 2014, Requests for Additional Information
Regarding STP Risk-Informed GSI-191 Licensing Application - Revised
(TAC NOs MF2400 and MF2401)

References:

1. Letter, G. T. Powell, STPNOC, to NRC Document Control Desk, "Supplement 1 to Revised STP Pilot Submittal and Requests for Exemptions and License Amendment for Risk-Informed Approach to Resolving Generic Safety Issue (GSI)-191, " November 13, 2013, NOC-AE-13003043, ML13323A183
2. Letter, Balwant Singal, NRC, to Dennis Koehl, STPNOC, "South Texas Project, Units 1 and 2- Request for Additional Information Related to Request for Exemptions and License Amendment for Use of a Risk-Informed Approach to Resolve the Issue of Potential Impact of Debris Blockage on Emergency Recirculation During Design-Basis Accidents at Pressurized-Water Reactors", April 15, 2014, ML14087A075
3. Letter, G. T. Powell, STPNOC, to NRC Document Control Desk, "First Set of Responses to April, 2014, Requests for Additional Information Regarding STP Risk-Informed GSI-191 Licensing Application," May 16, 2014, NOC-AE-14003097

This submittal withdraws and supersedes Reference 3 in its entirety. The response to RAI #4 from the Nuclear Performance and Code Review Branch (SNPB) in Enclosure 1 to Attachment 3 of Reference 3 unintentionally included proprietary information. STPNOC requests that this RAI response be removed from any sources of public access. The response to RAI#4 and the proprietary information that was enclosed has been removed from the attachments in this submittal and the submittal attachments are renumbered accordingly. There are no other changes.

This submittal responds to a portion of the requests for additional information (RAI) provided in Reference 2 with regard to the STP Nuclear Operating Company (STPNOC) risk-informed application to address GSI-191 (Reference 1). The responses provided are listed in the Attachments. Reference 2 included a June 13, 2014 due date for the RAI responses. STP and NRC have agreed that the expected completion date for responding to all of the RAIs in Reference 2 is June 27, 2014.

There are no regulatory commitments in this letter.

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NRR

STI33840343

If there are any questions, please contact Mr. Wayne Harrison at 361-972-8774.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: May 22, 2014

G. T. Powell

G. T. Powell

Site Vice President

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Attachments:

1. Response to APLAB Request for Additional Information
    a. CASA Grande - LOCA Frequencies: RAI 1, 3, 4
    b. CASA Grande to PRA Interface - General: RAI 1, 3, 4, 5, 6
    c. CASA Grande to PRA Interface - Human Reliability Analysis: RAI 1, 2, 4, 6
    d. CASA Grande to PRA Interface - PRA Scope: RAI 1
    e. Results Interpretation - Quantification: RAI 1, 2
    f. Results Interpretation – Uncertainty Analysis: RAI 2

    Enclosures to Attachment 1:
        1. ALION-REP-STP-8998-02, Rev. 0, "STP CASA Grande Analysis and LAR Enclosure 4-3 RAI Response"
        2. University of Texas white paper, "Means of Aggregation and NUREG-1829: Geometric and Arithmetic Means", Rev. 3

2. Response to ESGB Request for Additional Information:
    a. Chemical Effects: RAI 12,13,19
    b. Coatings: RAI 2, 3, 4, 5, 7

3. Response to SRXB Request for Additional Information: RAI 5, 6, 7, 8, 9
4. Response to SSIB Request for Additional Information:
    a. ZOI: RAI 1
    b. Debris Characteristics: RAI 2
    c. Transport: RAI 5, 9, 11, 13
    d. NPSH and Degasification: RAI 29
5. Response to STSB Request for Additional Information: RAI 1, 2, 3

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Attachment 1

Response to APLAB Request for Additional Information

a. CASA Grande - LOCA Frequencies: RAI 1, 3, 4
b. CASA Grande to PRA Interface - General: RAI 1, 3, 4, 5, 6
c. CASA Grande to PRA Interface - Human Reliability Analysis: RAI 1, 2, 4, 6
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APLAB, CASA GRANDE - LOCA Frequencies: RAI 1a

RG 1.174, Section 2.3.3 states that the PRA model should be technically adequate for the application. Volume 3, Section 5.3.1 (page 124 of 248) states, in part, that

> **... the relative weight[s] of breaks in various weld locations are based on specific degradation mechanisms for categories of welds. These frequencies were determined from an analysis of DM [degradation mechanism]-dependent weld failure rates based on service data, a Bayes method for uncertainty treatment developed in the [Electric Power Research Institute (EPRI)] risk-informed in-service inspection (RI-ISI) program, and estimates of conditional probability versus break size using information developed in NUREG-1829 ["Estimating Loss-of-Coolant Accident (LOCA) Frequencies Through the Elicitation Process," April 2008 (Volumes 1 and 2: ADAMS Accession Nos. ML082250436 and ML081060300)].**

(a) Although not explicitly quantified, factors other than break size were considered by the NUREG-1829 panelists when developing LOCA frequencies. For example, NUREG-1829, Section 6.3.2, "Important Aging Mechanisms," describes the panelists' consideration of factors such as thermal fatigue, flow-accelerated corrosion, inter-granular stress corrosion cracking, and mechanical fatigue. Please describe how these factors were used to quantify the break frequency for various pipe sizes. For any factors used in the STP pilot analysis that were already considered by the NUREG-1829 panelists, please explain why the proposed approach does not amount to "double counting."

STP Response:

Double counting of annual frequency for any break size is explicitly prevented by the hybrid methodology that preserves the exceedance frequency distributions from NUREG-1829. Although the total frequencies are preserved for any break size given in NUREG 1829, thereby preventing "double counting", the frequencies at any specific weld location were weighted according to the degradation mechanisms as described in the LAR Enclosure 4-3, Section 5.3. By this method, locations exposed to more degradation mechanisms are appropriately assigned a greater fraction of the total frequency (for that break size).

APLAB, CASA GRANDE - LOCA Frequencies: RAI 1b

(b) The NUREG-1829 "total" LOCA frequencies referenced by the STP pilot application include contributions from both piping and non-piping (e.g., nozzles, component bodies, pressurizer heater sleeves, man ways, and control rod drive mechanism penetrations) weld failures. As shown in NUREG-1829, Figure 7.7, the contribution from non-piping LOCAs can be significant and exceeds the contribution from piping LOCAs for several categories. The approach described in Volume 3, Section 5.3, "LOCA Frequency," of the STPNOC submittal distributes the total LOCA frequencies onto pipe welds only. While this preserves the overall initiating event frequency, it does not explicitly consider the debris generation, transport, etc. of LOCAs caused by these contributors. Please explain how the debris-related risk from non-piping contributors was estimated in this study. Please provide a justification for any non-piping contributors that were excluded from the analysis.

STP Response:

The exceedance frequencies given in NUREG 1829 that include non-piping component contribution were preserved and therefore contributions from non-piping components were included in the analysis.

Debris-related risk from non-piping contributors was examined from two perspectives: (1) potential for debris formation, and (2) proximity of nearby welds. Potential for debris formation is affected by both the potential magnitude of the break and by the proximity of insulation targets. For example, Reactor Coolant Pump (RCP) seal leaks were judged to be comparable to SBLOCA in terms of potential for generating insulation debris in the vicinity of the RCP. Pressurizer Relief Tank (PRT) relief valve opening was judged to have higher damage potential but very little collocated insulation that can be damaged.

Because overall initiating event frequencies are preserved, it is most important that pipe welds of comparable size to the non-piping contributors are located in the same proximity as the non-weld contributors of interest. Welds on large pipes are assigned a full range of break sizes, so they provide suitable surrogate coordinates for other rupture events that may occur in the same vicinity. For example, the first weld on hot and cold leg lines represents a sufficient location for reactor nozzle rupture.

The 775 welds considered in the pipe based LOCA frequency analysis are finely distributed over all the locations in the containment where significant debris generation is expected. Non-piping components that may contribute to a LOCA include nozzles, component bodies, pressurizer heater sleeves, man ways, control rod drive mechanism penetrations, safety and relief valves, reactor coolant pump seals, reactor vessel, pressurizer vessel, steam generator vessels, welded caps on retired lines and other components.

With the exception of non-pipe components that are located in the reactor cavity, all these non-pipe components are located at or near pipe welds. For example there are many weld locations in lines around the pressurizer vessel including the surge line,

spray lines, and the safety and relief valve lines that would be available to simulate non-pipe components in that area of the containment. In addition there are many welds distributed along the cold legs including those near the reactor coolant pumps that would simulate non-weld locations in those areas. The modeled welds that are located at the safe ends of the nozzles at the reactor vessel, pressurizer vessel, and steam generator vessel are reasonably close to the associated nozzle welds and are close enough to the vessels to produce a significant debris field from the insulation around those vessels. One category of non-pipe contributions to LOCA frequency that is not located near a modeled weld location would be that associated with non-pipe components associated with the reactor vessel located away from the hot leg and cold leg nozzles, e.g. control rod drive penetrations, man ways, and instrument lines connected to the reactor vessel. However these are located in the reactor cavity which was not found to be an important location for generating a transportable debris field.

APLAB, CASA GRANDE - LOCA Frequencies: RAI 3

RG 1.174, Section 2.3.2 states that the level of detail of the PRA model must be sufficient to model the impact of the proposed change. Volume 3, Section 5.3 describes the process used to define non-uniform "sample bins" for each weld case. Although this section describes the process used to determine the number of bins for a given weld, the process used to define the bin sizes is not discussed. Please provide a description of this process.

STP Response:

The bin sizes are determined by the following steps for each weld case:

1) Interpolate the CCDF of break-size frequency to find the exceedance frequency corresponding to each LOCA category limit (0.5 in., 2 in., 6 in.).
2) Divide into logarithmically equal bins the exceedance frequency interval for each LOCA category using the number of bins determined for each LOCA category.
3) Invert the logarithmic bin intervals by interpolation to find the corresponding break size intervals.

As an example, Equation 25 and Equation 26 of LAR Encl. 4-3 (Pg. 150) can be used to find the number of small and medium breaks with a user specified number of 10 large breaks (N_L) and a maximum pipe diameter in containment of 31.5 inches. Solving Equations 25 and 26 for the number of small (N_S) and medium breaks (N_M) yields N_S=1 and N_M=2, respectively. Figure 5.3.4 shows that the number of breaks for small, medium, and large breaks have been distributed equally in the log of exceedance frequency (y axis of plot) within their respective LOCA size category.

Using equal logarithmic spacing creates nonuniform probability weights that must be carried with each sampled break size. Using equal logarithmic spacing to sample a rapidly declining CCDF also forces samples to occur in the upper end of each LOCA category that would otherwise have a very small probability of being selected.

APLAB, CASA GRANDE - LOCA Frequencies: RAI 4

RG 1.174, Section 2.3.3 states that the PRA model should be technically adequate for the application. Volume 3 describes the process used to assign break frequencies to welds in containment and cites the following two documents listed as references 7 & 8:

> **Reference 7: KNF Consulting Services LLC and Scandpower Risk Management Inc. Development of LOCA Initiating Event Frequencies for South Texas Project GSI-191 Final Report for 2011 Work Scope. September 2011.**
>
> **Reference 8: University of Texas at Austin. Modeling and Sampling LOCA Frequency and Break Size for STP GSI-191 Resolution. September 2012.**

Please provide Reference 7 on the docket and clarify exactly which aspects of the aforementioned references (e.g., by providing specific section or equation numbers) are used in the STP pilot.

STP Response:

Reference 8 to Enclosure 4-3 was provided in correspondence dated December 23, 2013 (ML14015A311).

Reference 7 was provided to the NRC in support of a meeting on October 3, 2011, and is available in NRC's Agencywide Documents Access and Management System (ADAMS) via Accession Number ML112770237.

Details regarding application of the documents are given in Enclosure 1 to this attachment.

APLAB, CASA GRANDE to PRA Interface – General: RAI 1a

Page 3 of Enclosure 1 of letter dated November 13, 2013, states: "Failure modes leading to core damage are explicitly modeled, excluding those that were previously addressed for the plant using deterministic evaluations." Also, based on information on page 20 of Volume 3 CASA Grande does not analyze failure mechanisms 4 and 6 (ex-vessel effects and crud on clad, respectively) because they have already been addressed deterministically. This is inconsistent with the risk-informed approach as set forth in RG 1.174, Section 1, "Element 1: Define the Proposed Change," in that the licensee should identify those aspects of the plant's licensing basis (LB) that may be affected by the proposed change.

(a) Please provide a basis for excluding the two failure mechanisms (4 and 6) from the risk assessment.

STP Response:

Failure mechanism 4, "Debris penetration exceeds ex-vessel effects limits causing a variety of potential equipment and component failures due to wear or clogging," was addressed by a review of STPNOC's deterministic evaluation of the phenomena.

The Ex-vessel effects Downstream Effects evaluation was previously provided in STP Letter NOC-AE-08002372, "Supplement 4 to the Response to Generic Letter 2004-02", dated December 11, 2008 (ML083520326).

Ex-vessel downstream effects were reviewed for adequacy under the risk-informed application, and no additional or unusual STP-specific vulnerabilities to ex-vessel effects were identified. Review of the deterministic ex-vessel effects analysis was performed to address the requirements of RG 1.174 in terms of potential effects to the plant licensing basis.

Failure Mechanism 6, "Buildup of oxides, crud, LOCA-generated debris, and chemical precipitates on fuel cladding exceeds the limits for heat transfer resulting in unacceptably high peak cladding temperatures", was not excluded from the risk assessment.

In the STP LAR analysis of ex-vessel effects, oxides, crud, LOCA-generated debris, and chemical precipitates were not modeled as explicitly as other phenomenology. However, an estimate of crud release during a LOCA transient was introduced as a particulate source that accumulates in the debris bed and affects head loss. The STP LAR used an industry nominal crud release inventory of 24 lbm.

In the risk-informed context, ECCS failures initiated by mechanisms 4 and 6 are judged to be less probable than the most unlikely initiators that are considered in the study (ex. LBLOCA).

APLAB, CASA GRANDE to PRA Interface – General: RAI 1b

(b) Please identify other failure mechanisms or assumptions related to GSI-191 phenomena that rely on deterministic acceptance criteria (including deterministic criteria acceptable to the NRC) that were not included in the risk assessment.

STP Response:

Other failure mechanisms and assumptions related to GSI-191 phenomena that rely on deterministic acceptance criteria were included as point values and were not varied across physically plausible ranges including, but not limited to:

(1) ZOI size
(2) Latent debris quantities
(3) Core fiber limits related to boron,
(4) NPSH assumptions

Although these values have been used as individual factors in previously submitted deterministic analyses, they were included, and are considered for their potential risk impact.

APLAB, CASA GRANDE to PRA Interface – General: RAI 3

RG 1.174 Section 2.3.2 states that the level of detail of the PRA model must be sufficient to model the impact of the proposed change. Table 2.2.11 (Volume 3, page 43 of 248) provides the "frequency of success pump combination states." Please explain what this term means, how the frequencies in the column titled, "Pump State Frequency" were derived, and how they were used in the analysis (both CASA Grande and the PRA models).

STP Response:

Section 9 of Enclosure 4-2 to Reference 1 of the cover letter (i.e., Volume 2) describes what is meant by the frequency of successful pump combination states and presents the frequencies for each state. Briefly, these frequencies are for the sum of medium and large LOCA sequences requiring sump recirculation, also found not to result in core damage in the absence of GSI-191 phenomena, and each frequency is for an exclusive combination for the number of ECCS pumps running. The frequencies in the "Pump State Frequency" column of Table 2.2.11 come directly from column 2 of Table 9-1 in Volume 2, though they are resorted by the number of pumps working rather than by the frequency of each pump state, as in Table 9-1 of Volume 2.

The probabilities for the occurrence of the different GSI-191 phenomena sufficient to cause failure are derived by CASA Grande separately for different ECCS pump combination states. Only the highest frequency ranked pump combination states were evaluated since those are the ones with the greatest potential to increase core damage frequency. For example, there is no need to evaluate pump combination states where the low pressure injection pumps all fail since such combinations already leads to core damage, independent of the GSI-191 phenomena. The PRA models apply these probabilities along each sequence in the PRA model to determine the frequency of sequences resulting in core damage due to GSI-191 phenomena. The PRA models do not use the frequencies of these states; rather the frequencies are only used to determine which pump combination states to be evaluated by CASA Grande. Five pump states were analyzed in CASA Grande.

For those successful pump state combinations not evaluated by CASA Grande, the PRA conservatively assumed that all corresponding sequences then lead to core damage with probability 1 due to GSI-191 phenomena.

APLAB, CASA GRANDE to PRA Interface – General: RAI 4a

RG 1.174, Section 2.3.3 states that the PRA model should be technically adequate for the application. Assumption 4 on page 6 of Volume 2 states, in part, that

> **The CASA GRANDE models assume containment systems are successful (containment purge isolation, isolation of small containment penetrations, that at least two of six fan coolers operate, and that CCW is available to the RHR heat exchangers) for purposes of evaluating sump failure probabilities.**

High level requirement LE-E of American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) RA-Sa 2009 ("The ASME PRA Standard") states: "The frequency of different containment failure modes leading to a large early release shall be quantified and aggregated." Please provide the following information for accident scenarios where the containment is not successfully isolated or where some containment systems do not operate as assumed:

(a) Please explain whether the probabilities of the various debris-related failure mechanisms are different for such scenarios.

<u>STP Response:</u>

Yes, the probabilities of various debris-related failure mechanisms are different for scenarios where some containment systems do not operate as assumed. However, no credit is taken in the analysis for containment pressure above vapor saturation, so lack of containment isolation does not affect the conditional probability of ECCS failure calculated by CASA Grande.

Conditional probability of ECCS failure depends on sump temperature histories that are affected by containment system performance. Thermal hydraulic analyses (LAR Encl. 4-3, Ref. 5) have focused on nominal containment operating conditions, but some containment failure states have been assessed. Conditional probability of ECCS failure under degraded containment system performance is inherently different from the conditional probability of ECCS failure under nominal conditions because of the equipment failure frequencies that are introduced. Conditional probability of ECCS failure under degraded conditions can also vary because of phenomenological dependence on temperature, including chemical corrosion and precipitation, $NPSH_{Available}$, and degasification potential.

Current analyses assume a single representative temperature history for small and medium breaks and a single representative temperature history for large breaks, all computed for nominal operating conditions (LAR Encl. 4-3, Figure 2.2.1, Pg. 46). This approach implicitly assumes that the occurrence frequency for alternate temperature histories is very small. The PRA can provide a basis for weighting the frequency of containment equipment failure in much the same way that the PRA provides a basis for weighting the frequency of pump failure states, but the weight associated with complex combinations of equipment failure rapidly declines (LAR Encl. 4-2, Section 10).

APLAB, CASA GRANDE to PRA Interface – General: RAI 4b

(b) Please explain how any differences in those probabilities are accounted for in the PRA model.

STP Response:

Potential differences in ECCS failure probability caused by containment system failure states are not addressed explicitly in the PRA because the PRA model considers the probability of containment system failures independent of the sump failure probabilities generated by CASA Grande; i.e., the system failure probabilities are not modified based on any GSI-191 related effects. The probability of containment isolation or fan cooler success is not affected by GSI-191 phenomena. Section 10 of Volume 2 (LAR Encl. 4-2) describes the results of sensitivity analysis to justify the approach assumed. To summarize that discussion; the frequency of medium or large break LOCAs with degraded containment system states, and which avoid core damage, is very low. Since GSI-191 phenomena can only increase core damage by moving a portion of these success sequences to core damage, the contribution of such sequences with degraded containment systems to the total GSI-191 phenomena impact is even smaller.

APLAB, CASA GRANDE to PRA Interface – General: RAI 4c

(c) Please explain how the above assumption for CASA Grande meets high level requirement LE-E of the PRA Standard.

STP Response:

The different containment failure modes referred to in high-level requirement HLR LE-E are those listed in Table 2-2.8-9 of "The ASME PRA Standard". The STP PRA is a full Level 1-Level 2 study that also evaluates large early release frequency consistent with the "The ASME PRA Standard". The active containment system failures are fully represented in the STP PRA as are the phenomena required by Table 2-2.8-9. While the analysis in CASA Grande assumed success of the active containment systems for purposes of computing the conditional probabilities of failing any of the 7 failure modes of GSI-191, the STP PRA considered all such failures. If in a given PRA sequence, the GSI-191 phenomena led to the failure of sump recirculation, this impact was accounted for in the performance of containment spray recirculation when determining the sequence Level 2 end states. The GSI-191 phenomena have no impact on the probabilities of successful fan cooler operation, nor of containment isolation.

APLAB, CASA GRANDE to PRA Interface – General: RAI 5

RG 1.174, Section 2.3.2 states that the level of detail of the PRA model must be sufficient to model the impact of the proposed change. Volume 2, page 25 states, in part, that

> **Early on in the assessment of GSI-191 phenomena it was determined that the only sequence classes requiring sump recirculation that would be affected are medium LOCAs (2"–6" diameter breaks) and large LOCAs (>6" diameter breaks).**

Also, Volume 1, page 24 states, in part, that

> **No failures were recorded for small- or medium-break events, and it transpired that only the higher range of large-break events contributed to failure. In addition to the composite PRA failure modes, total failure probability conditioned on the LOCA category is provided.**

PRA models often include high and low pressure recirculation in event trees for small LOCAs. Please explain how it was determined that only medium and large LOCAs would require sump recirculation. Also, please explain why there were no failures for small or medium LOCAs, including an explanation of the physical phenomena that led to this result. Please include in this explanation a statement as to whether this result was due to insufficient debris generation or Volume 3, page 81, Assumption 11.

STP Response:

It was not concluded that only medium and large LOCAs would require sump recirculation. It was concluded that only medium and large LOCAs would both require sump recirculation and potentially be affected by GSI-191 phenomena. Small LOCAs which also require recirculation are much less likely to be affected because the amount of dislodged debris is much less and containment spray is not automatically actuated for such scenarios. Containment spray is needed to transport the containment latent debris and any dislodged insulation to the sump.

Since the initial preparation of Volume 2 (LAR Encl. 4-2), it has been confirmed that only large LOCA scenarios are able to challenge ECCS performance metrics at STP as shown in Figure 1. ECCS performance metrics address physical phenomena associated with debris-induced effects on (1) strainer mechanical buckling, (2) NPSH margin, (3) degasification, (4) core fiber inventory associated with blockage for hot leg and cold leg breaks and (5) core fiber inventory associated with onset of boron precipitation for hot leg and cold leg breaks. None of the user-specified thresholds for these performance metrics are challenged by small and medium break scenarios at STP. Because transport fractions and failed coatings sources are largely constant for all scenarios, successful performance of small and medium break scenarios is attributed to smaller insulation debris volume.

LAR Encl. 4-3 (Volume 3) Assumption 11c, page 82 of 248 correctly states that boron precipitation failures were not explicitly precluded for small breaks (either cold leg or hot leg), and in fact, were not precluded for any cold leg breaks. LAR Encl. 4-3 Assumption 11d states that medium and large, and in fact all, hot leg breaks were

precluded from boron precipitation. Assumption 11d contributes to the success states of small and medium breaks, but does not override the dominant consideration of smaller debris volume.

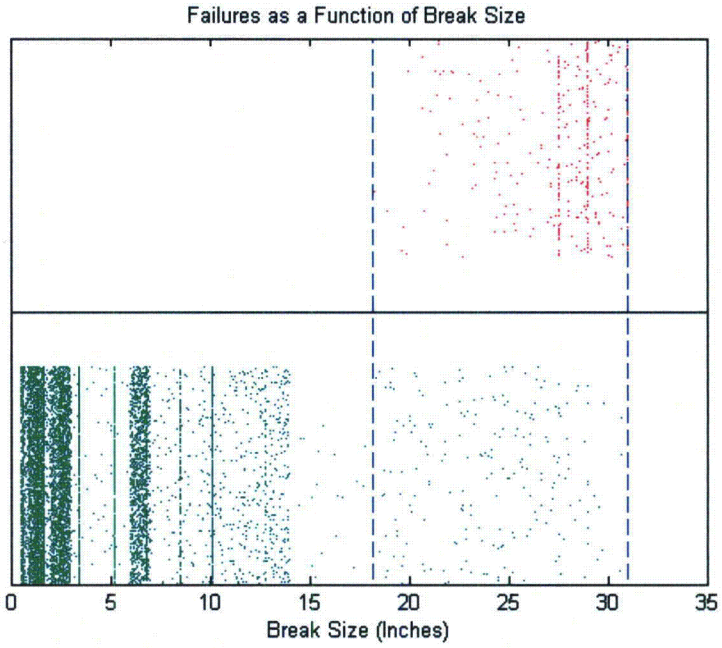

Figure 1. ECCS success (green) and failure (red) as a function of break size. Blue dashed lines mark the smallest break that can challenge ECCS performance metrics and the largest break that can pass ECCS performance metrics.

APLAB, CASA GRANDE to PRA Interface – General: RAI 6a

RG 1.174 Section 2.2 states that it is essential the uncertainties be recognized when assessing whether the principles of risk-informed decision-making are met. Page 84, Volume 2 states, in part, that

> **The failure probabilities for [Top Event SUMP] are provided directly from CASA GRANDE output in Volume 3. The uncertainty in these failure probabilities [is] reported as discrete probability distributions with 5 points each.**

This appears to conflict with Volume 3, Section 6 (page 233), which states that 15 point estimates of conditional failure probability are "averaged for use by the PRA."

(a) Please explain how many point estimates (i.e., distinct conditional failure probabilities) associated with a single frequency vs. break size curve (e.g., one curve from figure 6.1 in Volume 3) were computed by CASA Grande.

<u>STP Response:</u>

Fifteen (15) samples of the break frequency vs. size curves were generated for each pump state analyzed in the STP study.

The inconsistency in the document sections has been entered in the STP corrective action program to track correction for future submittals.

APLAB, CASA GRANDE to PRA Interface – General: RAI 6b

(b) Were these parameters passed to the PRA as a probability mass function, probability density function, or as a single mean value?

STP Response:

Tables such as Table 6.2 of LAR Encl. 4-3 were passed to the PRA for each of the five plant failure states. The tables are generated as standard CASA Grande output with the names:

DistOfCondBlockFailProb
DistOfConBoronFailProb
DistOfConSumpFailProb
DistOfConTotalFailProb

They contain independent point estimates of mean failure probability (unsorted) and the weights associated with each sample from the truncated Johnson uncertainty envelope defined for annual frequency as a function of break size.

APLAB, CASA GRANDE to PRA Interface – General: RAI 6c

(c) Please explain how were these point estimates used in the PRA parameter uncertainty evaluation?

STP Response:

The statement on page 84 of Volume 2 (LAR Encl. 4-2) is carried over from an earlier draft of the analysis where 5 points were used to represent the failure probability distributions for top events SUMP, FBLK, and BORON. The LAR calculation is based on 15 points as described in Section 6 of Volume 3 (LAR Encl. 4-3) for each of these three top events. The Volume 2 statement should read: "The uncertainty in these failure probabilities is reported as discrete probability distributions with 15 points each." As noted above, this has been entered in the STP corrective action program to track for correction in future submittals.

APLAB, STP PRA Model - Human Reliability Analysis: RAI 1

RG 1.174, Sections 2.3.1, "Scope," and 2.3.2, "Level of Detail Required to Support an Application," state that the scope and level of detail of the PRA model must be sufficient to model the impact of the proposed change. Assumption 3.c in Volume 3 states that isolable breaks can be excluded from the evaluation since isolable breaks would not lead to recirculation. Please explain the basis for this assumption. Please describe what human error probability was used for the failure to isolate an isolable break. Please state whether there are any isolable breaks that could, if not isolated, result in the need to enter the ECCS recirculation mode.

STP Response:

In the STP PRA, isolable small LOCAs refers to the set of small LOCAs originating in the pressurizer Power Operated Relief Valve (PORV) lines which can be isolated by closing the associated PORV block valve. The frequency of such events is taken to be 9.2E-4 per year. Since the time available for action and the power necessary to close the block valve is dependent on the full scenario, credit for isolation of the LOCA by closing of the PORV block valve is only taken at the end of the sequence. The operator action to close the PORV block valve is assigned a human error probability of 1.58E-5, but it is only applied when power is available to the block valve and high pressure injection is successful allowing nearly 10 hours before Refueling Water Storage Tank (RWST) depletion for a successful response.

Assumption 3.c in Volume 3 could be better stated to say that if left unisolated, isolable LOCAs may require sump recirculation. Crediting isolation, however, would greatly lower the frequency of the isolable LOCA sequences requiring sump recirculation. Since the isolable LOCAs originate in the pressurizer PORV line (typically as leakage past the PORVs themselves), they discharge to the Pressurizer Relief Tank (PRT). Therefore, they are not expected to dislodge appreciable debris, and by being within the small LOCA size, they would not actuate containment spray. The combination of being insufficient to generate a spray actuation signal and not dislodging any appreciable debris is the basis for not considering isolable LOCAs further.

APLAB, STP PRA Model - Human Reliability Analysis: RAI 2

RG 1.174, Sections 2.3.1 and 2.3.2 state that the scope and level of detail of the PRA model must be sufficient to model the impact of the proposed change. Under certain conditions, operator actions required to start or secure the pumps may depend on the effects of the debris generated by the specific pipe break. Please describe if CASA Grande considers the potential for the number of running pumps to change during a scenario because of operator actions taken in response to cues that debris is building up on the sump.

STP Response:

CASA Grande does not currently consider the potential for the number of running pumps to change based on indications of debris build up. The only change in pump status currently addressed is securing sprays according to the Emergency Operating Procedures (EOP).

APLAB, STP PRA Model - Human Reliability Analysis: RAI 4a

RG 1.174, Section 2.3.2 states that the level of detail of the PRA model must be sufficient to model the impact of the proposed change. Volume 2, page 85 states that the probability of excess boron precipitation (top event BORON) depends on three factors: (1) whether the break is in the cold leg; (2) the extent of core flow blockage prior to hot-leg switchover; and, (3) whether a low head safety injection (LHSI) train is realigned for hot-leg recirculation.

(a) Please provide the probability assigned to BORON for each combination of these three factors used in the PRA model. A table or graphic may be a useful way to provide this information.

STP Response:

A table of the probabilities of failing top event BORON and the associated status of break size, break location, status of hot leg recirculation switchover, and ECCS pump states is provided below. The number of high head pumps, low head pumps, and spray pumps operating in each pump state is indicated. The CASA Grande results account for the location of the break (i.e., hot or cold leg) when determining the probability of core flow blockage for a given break size. The CASA Grande results are used directly for the split fractions of top event BORON when hot leg recirculation switchover is successful; as its success precludes excessive boron precipitation at later times. When alignment for hot leg recirculation fails, excessive boron precipitation leading to core flow blockage is assumed to lead to core damage for the proportion of breaks located in the cold legs. The cold leg proportions of the break size are as determined in the sampling within CASA Grande; i.e., 0.381 for Medium LOCAs and 0.256 for Large LOCAs.

Split Fraction ID	Split Fraction Value – Probability of Core Flow Blockage	Break Size	Status of Hot Leg Recirculation	Break Location (cold/hot)	Applicable Pump State(s)
BORML	0.381	Medium	Failed	0.381 cold leg fraction for Medium LOCAs	All pump states
BORLL	0.256	Large	Failed	0.256 cold leg fraction for Large LOCAs	All pump states
BML1S	0[1]	Medium	Success	CASA result for pump state 1	Pump state 1: H3L3S3
BML9S	0	Medium	Success	CASA result for pump state 9	Pump state 9: H3L1S3

[1] A value of zero is assigned to a split fraction representing 'success.'

Split Fraction ID	Split Fraction Value – Probability of Core Flow Blockage	Break Size	Status of Hot Leg Recirculation	Break Location (cold/hot)	Applicable Pump State(s)
BML22S	0	Medium	Success	CASA result for pump state 22	Pump state 22: H2L2S2
BML26S	0	Medium	Success	CASA result for pump state 26	Pump state 26: H2L1S2
BML43S	0	Medium	Success	CASA result for pump state 43	Pump state 43
BLL1S	1.25×10^{-3}	Large	Success	CASA result for pump state 1, considers fraction in cold leg	Pump state 1: H3L3S3
BLL9S	2.85×10^{-3}	Large	Success	CASA result for pump state 9, considers fraction in cold leg	Pump state 9: H3L1S3
BLL22S	2.54×10^{-4}	Large	Success	CASA result for pump state 22, considers fraction in cold leg	Pump state 22: H2L2S2
BLL26S	3.07×10^{-4}	Large	Success	CASA result for pump state 26, considers fraction in cold leg	Pump state 26: H2L1S2
BLL43S	1.04×10^{-5}	Large	Success	CASA result for pump state 43, considers fraction in cold leg	Pump state 43
BMLGF	0.381	Medium	Either	0.381 cold leg fraction for Medium LOCAs	All other pump states
BLLGF	0.256	Large	Either	0.256 cold leg fraction for Large LOCAs	All other pump states

APLAB, STP PRA Model - Human Reliability Analysis: RAI 4b

(b) Assumption 1.j in Volume 3 (page 72 of 248) states that switchover to hot leg injection (factor 3) is assumed to occur between 5.75 and 6 hours after the start of the event. Please describe how the human error probabilities (HEPs) associated with this top event ("HLEG") were developed and how they account for LOCA size and plant configuration (e.g., number of pumps available, impact of debris, etc.), as well as factors 1 and 2 defined above.

STP Response:

For reference, General assumption 1.j from Volume 3 states: It was assumed that switchover to hot leg injection would occur between 5.75 and 6 hours after the start of the event. This is a reasonable assumption since the switchover procedure is started 5.5 hours after the start of the event and timing of EOP step completion, switchover for both trains can be completed within 15 minutes.

The human error probability for the action to switchover for hot leg recirculation is represented by data variable HEHLR. Reference 1 documents the quantification of this human error probability. The human reliability analysis assumes that the scenario results from a Large LOCA. If RCS pressure remains above 415 psig by the time the operators reach step 21 of 0POP05-EO-EO10 Rev. 22, then the operators would instead transfer to 0POP05-EO-ES12, POST LOCA COOLDOWN AND DEPRESSURIZATION. However, for the larger LOCAs, the initiation of Hot Leg Recirculation is cued from 0POP05-EO-EO10 Rev. 22, Step 28 which procedure directs the operators to go to 0POP05-EO-ES14, TRANSFER TO HOT LEG RECIRCULATION, at 5.5 hours. The operators are directed to transfer the High Head Safety Injection (HHSI) to hot leg recirculation by energize and open a HHSI hot leg injection MOV and then closing the HHSI cold leg injection valve. The procedure then aligns the Low Head Safety Injection (LHSI) by locally energize a LHSI cold leg injection MOV (redundant step is in 0POP05-EO-EO10 step 27), energize and open a LHSI hot leg injection MOV from the Control Room, and then also from the control room close the LHSI cold leg injection MOV. A caution at the beginning of 0POP05-EO-ES14 directs that one SI train is to remain aligned for cold leg recirculation in case the LOCA was a rupture of an RCS hot leg. All remaining SI trains are to be aligned for hot leg recirculation. The EPRI HRA Calculator was used to compute a total HEP for this action of 3.6×10^{-5} as documented in Reference 1. Both cognitive and execution errors were considered in the assessment. The time available for action following the cue was assumed to be 2 hours, although the expected time to completion is just 15 minutes. Credit was taken for action recovery by the emergency response organization since the action would take place well after 1 hour from the start of the accident.

Only one HEP was found necessary to account for the factors noted. Each of these factors is discussed below.

LOCA size – This action is only required for the larger break LOCAs; i.e., for Medium and Large LOCAs. It is not required for Small LOCAs because the RCS pressure would remain above 415 psig. The initiation cue and time available for action is not dependent on the specific break size so just one action was assessed.

Plant configuration (e.g., number of pumps available) – The procedural guidance directing hot leg recirculation switchover is only partly dependent on the number of pumps available. If only one train of the LHSI pumps is operating in the cold leg recirculation mode at 5.5 hours after accident initiation, then hot leg recirculation switchover was assumed failed. This is consistent with the caution in 0POP5-EO-ES14, TRANSFER TO HOT LEG RECIRCULATION. If multiple LHSI pumps are operating in cold leg recirculation mode, then all but one is credited in completing the transfer to hot leg recirculation to an RCS loop that remains intact. To simplify the analysis, the model assumes that the operators preferentially transfer to hot leg recirculation using Trains A and then B, never transferring Train C. The accident sequence keeps track of the RCS loop with the break though this knowledge is assumed not available to the operators; i.e., the model allows the operators to align an LHSI pump to a broken RCS loop in which case that train is not assumed to be successful for hot leg recirculation.

Plant configuration (e.g., impact of debris, etc.) – The loading of debris on the sump strainers has no impact on the action to align for hot leg recirculation. If the loading is sufficient to cause an LHSI pump to lose its function, then failure of all three sumps are conservatively assumed lost, overstating the impact of GSI-191 phenomena in the assessment.

Whether the break is in the cold leg – The procedural guidance is not dependent on the break location being in the cold or hot legs. The same actions are taken. The procedural caution to leave one train of SI aligned to the cold legs is always observed no matter what the operators determine as to the location of the break.

The extent of core flow blockage prior to hot leg switchover – For the assessment of the effect of GSI-191 phenomena, only boron precipitation prior to the time of hot leg recirculation is of interest. Boron precipitation after the time of hot leg recirculation is already considered in the base PRA. If the break is in the hot leg, boron precipitation is not at issue. If the break is in the cold leg, and hot leg recirculation is not aligned, then for the Medium and Large LOCA break sizes, boron precipitation leading to loss of core cooling is always assumed regardless of the GSI-191 phenomena.

Reference

1. South Texas Project Human Reliability Analysis Notebook, STI 32746637.

APLAB, STP PRA Model - Human Reliability Analysis: RAI 6

RG 1.174, Section 2.5.5, "Comparison with Acceptance Guidelines," states that care should be taken to ensure that there are no unquantified detrimental impacts to proposed changes, such as an increase in operator burden. Section C.5.8, "Mitigation of Inadequate Reactor Core Flow," of Appendix C to Volume 1 lists a number of operator actions associated with debris. For operator actions that apply in both the GSI-191 PRA base case model and the GSI-191 PRA debris model, please explain how each operator action's HEP was modified as a result of debris consistent with ASME HLR-HR-G, which states that scenario-specific influences on human performance should be addressed

STP Response:

The operator actions described in Section C.5.8 of Appendix C to Volume 1 are for inadequate reactor core flow conditions. The operator actions modeled in the PRA evaluation of GSI-191 phenomena are instead for conditions in which reactor core flow is adequate. The GSI-191 phenomena are then imposed on these otherwise successful scenarios. No credit is given for the additional operator actions discussed in Section C.5.8 mitigating the potential inadequate reactor core flow conditions that may be caused by GSI-191 phenomena as evaluated in CASA Grande. The operator actions listed in C.5.8 are intended to demonstrate the defense in depth available to deal with such phenomena should they occur.

The actions credited for Medium and Large break LOCAs are presented in the event sequence diagram of Appendix A, Figure A.3.1 of Volume 2. The operator actions are modeled in top events OR, OS1, OFFS, and HLEG. These are briefly discussed below.

Top Event OR represents the operator action to manually actuate safety injection whenever ESFAS fails to generate a safety injection signal. This action is required early in the scenario following a Medium or Large break LOCA initiator.

Top Event OS1 represents the manual action to secure one train of containment spray if all three are initially running, to conserve Refueling Water Storage Tank (RWST) water. This action is unrelated to the presence of debris. While included in the PRA event tree model, the status of this top event is not considered in subsequent events. Instead, the CASA Grande simulation accounts for this action by the assumed times of its implementation.

Top Event OFFS represents the manual action to secure all trains of containment spray when the containment pressure falls to 6.5 psig and the Technical Support Center (TSC) concurs. This action is unrelated to the presence of debris. While included in the PRA event tree model, the status of this top event is not considered in subsequent events. Instead, the CASA Grande simulation accounts for this action by the assumed times of its implementation. This action is not expected to be implemented until 6.5 hours after a design basis LOCA per 0POP05-EO-EO10.

Top Event HLEG represents the action and equipment necessary to align at least one low head safety injection train to the associated RCS hot leg. The operator action is not modeled as varying with the amount of debris because by procedure it is entered when 5.5 hours have elapsed following the break.

APLAB, STP PRA Model - PRA Scope: RAI 1

A seismic event may potentially dislodge and transport insulation to the containment sump. Any subsequent sequence of events that leads to recirculation from the ECCS sump could be adversely impacted by debris. RG 1.174, Section 2.3.1 states that the scope of the PRA model must be sufficient to model the impact of the proposed change. Please identify such accident sequences and estimate the increase in core damage and large early release frequencies due to a seismic event as a result of having debris sources in the containment.

STP Response:

Fragility curves for seismic initiated LOCAs were not developed as part of the existing PRA for South Texas Project. Such LOCAs would have to occur before transport to the sump of dislodged insulation would be of concern. The original evaluation of seismic failures at STP concluded that such failures of the RCS would have median failure capacities greater than 2.0g; i.e., see Reference 3. Figure 3.6 of Reference 1 presents generic fragility curves for the conditional probability of a Small or Medium size LOCA in response to a given earthquake ground motion. More recently, in Reference 2, EPRI then curve fit these plots (see Table H-2 of Reference 2) to convert them to standard form. A representative fragility curve for Large LOCAs is also presented in Reference 2. Information from Reference 2 is provided in the table below.

LOCA Size	Median Acceleration	Beta-r	Beta-u	HCLPF
Small	1.0	.3	.4	.315
Medium	2.0	.35	.45	.534
Large	2.5	.3	.4	.788

Most recently STP submitted to the USNRC its response to the request for information to Recommendation Task 2.1 of the Near-Term Task Force in response to the Fukushima event (Reference 4). Table 2.2.2-1g of Reference 4 provides an up-to-date mean frequency exceedance curve for the seismic hazard at STP. By convoluting this hazard curve with the Small, Medium, and Large LOCA Fragilities noted in the above table, the frequency of Small, Medium, and Large LOCAs initiated by seismic events at STP is found to be 4.25×10^{-7} per year for Small LOCAs, 1.08×10^{-7} per year for Medium LOCAs and 5.06×10^{-8} per year for Large LOCAs.

Clearly the potential for the dislodgement of insulation by seismic shaking to be of concern is a function of the hazard curve assumed. For Small LOCAs, transport to the sump would be minimal because the containment sprays would not be initiated. For larger breaks, which likely would initiate containment spray, the frequency of such seismically initiated breaks is much lower. Because the insulation is contained inside a robust fabric covering designed for handling, any insulation that failed would fall off in relatively large clumps which would be less likely to transport. Even assuming no credit for sump recirculation following a seismic event, the impact would be very small. While no fragility analysis has been performed on pipe insulation away from the break, where such insulation is assumed to be dislodged, the chances of the insulation failing and being transported to the sump must be small. Even assuming a probability of 0.1 that sufficient insulation is dislodged and transported to the containment sumps to cause

sump plugging, the impact of recirculation failure for Medium and Large LOCAs initiated by seismic events would then be very small; i.e., $0.1*(1.08x10^{-7} + 5.06x10^{-8}) = 1.6x10^{-8}$ per year, assuming latest STP-specific seismic hazard mean curve applies.

References

1. M.P. Bohn, J.A. Lambright, "Procedures for the External Event Core Damage Frequency Analyses for NUREG-1150", NUREG/CR-4840, Sandia National Laboratories, prepared for US Nuclear Regulatory Commission, November 1990.

2. EPRI 3002000709, "Seismic Probabilistic Risk Assessment Implementation Guide", Final Report, December 2013, Project Manager J. Sursock.

3. D.A. Wesely, et al., "Seismic Fragilities of Selected Structures and Components at the South Texas Plant", prepared for Pickard, Lowe and Garrick, Inc. by National Technical Systems, June 1987. HL&P1060-DOC-353 (c.3), Report No. 1628.

4. Letter from G.T. Powell to U.S.NRC, "Seismic Hazard and Screening Report (CEUS Sites), Response NRC Request for Information Pursuant to 10CFR50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force, Review of Insights from the Fukushima Dai-ichi Accident," NOC-AE-14003114, Dated March 31, 2014. (ML14099A235)

APLAB, Results Interpretation – Quantification: RAI 1a

Volume 2, page 3 states, in part, that

> **The change in core damage frequency and large early release frequency is determined by comparing the results of two models: one with no source material in the containment capable of producing any GSI-191 effects and one representing the current plant conditions that includes both fibrous insulation that might be liberated following a LOCA and latent material found in the containment.**

Also, elsewhere in the submittal, it says "failure branches" are not included since they lead to core damage with or without debris. This would imply that the analysis produced the delta risk directly by considering "success branches" that would be impacted by debris, without the need to subtract a base-case risk. It is important that the NRC staff understand how the risk was calculated. RG 1.174 Section 2.2 states that the licensee should assess the expected change in CDF and LERF. Please provide the following:

(a) Please clarify whether the ΔCDF and ΔLERF were calculated by summing only the former success states that go to core damage due to GSI-191 phenomena or by requantifying the entire debris model and subtracting the base case.

<u>STP Response:</u>

The values reported for ΔCDF and ΔLERF were calculated by requantifying CDF and LERF assuming the entire GSI-191 phenomena models and then subtracting the base case CDF and LERF which did not consider GSI-191 phenomena. Since arguments were provided to show that only the medium and large LOCA initiators could conceivably contribute via consideration of GSI-191 phenomena, the requantification of CDF and LERF was restricted to just these two initiators. The ΔCDF and ΔLERF from other initiators is too small to be of interest.

The references mentioned to "success branches" and the exclusion of "failure branches" refers to the computation of the highest frequency pump states of interest. These pump states were determined for the purpose of defining the pump combination states of most interest to evaluate in CASA Grande. They are not used directly in computing ΔCDF and ΔLERF.

APLAB, Results Interpretation – Quantification: RAI 1b

(b) Please explain if the same LOCA initiating event frequencies and parameter uncertainty distributions were used for both the baseline and debris models.

STP Response:

The same LOCA initiating event frequencies and parameter uncertainty distributions were used for both the baseline and debris models.

APLAB, Results Interpretation – Quantification: RAI 2

Please provide a list of the top 100 accident sequences that result in core damage due to one of the seven failure mechanisms identified in Volume 1; that is, include only sequences that include failure of recirculation core damage resulting from as a result of GSI-191 phenomena.

STP Response:

Appendix A to Volume 2 presents top events in the Medium and Large LOCA event tree set. The top events representing the seven failure mechanisms are described in the late Medium LOCA event tree; i.e., Top Event SUMP combines the failure mechanisms at the sump strainer (i.e., sump plugging resulting in insufficient flow, loss of NPSH, pump cavitation caused by air ingress, and strainer collapse by excessive loading); Top Event FBLK represents the failure modes for blockage of the core (i.e., excessive plugging within the reactor vessel of the coolant flow path to the core fuel tubes), and Top Event BORON represents the failure mode of excessive boron precipitation sufficient to prevent extended core cooling.

Top Event FBLK is assigned zero probability of occurrence as a result of the CASA Grande analysis. Therefore, the sequences that result in core damage frequency due to failure of recirculation from GSI-191 phenomena are those limited to cases when either of Top Events SUMP or BORON fail.

To obtain the top 100 sequences leading to core damage from only GSI-191 phenomena, a sequence group was defined that restricts the sequences in the group to those initiated by either Medium LOCA or Large LOCA, which lead to core damage and which involve failure of one of the split fractions for top event SUMP or BORON. The top 100 sequences of this sequence group are listed in the following table. Note the list of sequences in Volume 2 (Table 4-7) identifies example sequences leading to core damage involving Medium and Large LOCAs and involving GSI-191 phenomena. That table provides additional insight into the nature of the scenarios involving GSI-191 phenomena that lead to core damage.

For each sequence in the group, the following is presented:

- Sequence Rank
- Initiating Event Name
- Initiating Event Frequency
- Split Fraction Name
- Split Fraction Failure Probability
- Top Event – Split Fraction Description
- End State Name
- Overall Sequence Frequency
- % Contribution to the Total Sequence Group; i.e., 3.07×10^{-8} per year

Note that sequences differ depending on the assumed location of the broken RCS loop, the initial status of maintenance, the trains normally running, as well as the specific GSI-191 split fraction which is determined by the ECCS pump state.

The sequence group total of 3.07×10^{-8} per year is slightly greater than the increase in core damage frequency reported in Volume 2, below Table 4-2, as 2.88×10^{-8} per year. The reason for this slight increase is that in the model including GSI-191 phenomena, some sequences are now assigned to core damage because of GSI-191 phenomena that were already assigned to core damage in the base model without GSI-191 phenomena. For example, if a low frequency pump state is one of the default states, the associated Medium and Large LOCAs sequences are assigned to core damage because of GSI-191 phenomena. Some of these sequences are listed in the table below. A portion of these sequences are also assigned to core damage in the base model due to loss of both RHR heat exchanger cooling and containment fan cooler cooling. These multiple causes of core damage are accounted for when subtracting the totals to obtain the change in core damage frequency due to GSI-191 phenomena. The 2.88×10^{-8} per year value is therefore the appropriate value for the increase in core damage frequency.

The top 100 sequences leading to core damage due to GSI-191 phenomena are listed in the following table.

Top 100 Sequences Involving GSI-191 Phenomenon

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.[2]	% of Group
1	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.04E-09	3.38
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00[3]	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
2	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.04E-09	3.38
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			

[2] Sequences identified by RISKMAN™ represent a unique path through the scenario model. The sequence includes both successes and failures that uniquely define the path through the event tree. The sequence frequency therefore includes the product of the individual split fraction success likelihoods and the individual split fraction failure likelihoods associated with that sequence. For example, the product of the failed split fractions for the first sequence listed above is 1.16×10^{-9} per year. The product of the associated successful split fractions is 0.893. The frequency of this sequence is $1.16 \times 10^{-9} \times 0.893 = 1.04 \times 10^{-9}$ per year.

[3] A value of unity is assigned to a split fraction representing 'failures' that are not stochastic in nature.

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
3	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.04E-09	3.38
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
4	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.04E-09	3.38
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
5	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.04E-09	3.37

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
6	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.03E-09	3.37
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
7	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.03E-09	3.37
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
8	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.03E-09	3.37
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
9	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.03E-09	3.37
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
10	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.03E-09	3.36
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
11	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.03E-09	3.36
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
12	LLOCA	5.20E-06	Large LOCA		MELTSUMP	1.03E-09	3.36
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
13	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.80E-10	1.24
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
14	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.80E-10	1.24
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
15	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.79E-10	1.24
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
16	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.79E-10	1.23
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEBCA	2.67E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains C, A Running			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
17	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.79E-10	1.23
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
18	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.79E-10	1.23
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
19	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.78E-10	1.23
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
20	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.78E-10	1.23
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
21	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.78E-10	1.23
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEBBC	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains B, C Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
22	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.78E-10	1.23
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
23	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.77E-10	1.23
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
24	LLOCA	5.20E-06	Large LOCA		MELTBORON	3.77E-10	1.23
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEBAB	2.66E-01	-	GENERIC PLANNED MAINTENANCE - No Planned Maint, Trains A, B Running			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
25	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	8.02E-11	0.26
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	SI38BA	1.56E-04	-	SI38 PATH B - SI38 PATH B - SI38A=S			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
26	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	8.02E-11	0.26
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	SI38BA	1.56E-04	-	SI38 PATH B - SI38 PATH B - SI38A=S			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
27	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	8.02E-11	0.26
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	SI38BA	1.56E-04	-	SI38 PATH B - SI38 PATH B - SI38A=S			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
28	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.98E-11	0.26
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	SI38AA	1.55E-04	-	SI38 PATH A - SI38 PATH A			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
29	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.97E-11	0.26
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	SI38AA	1.55E-04	-	SI38 PATH A - SI38 PATH A			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
30	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.97E-11	0.26
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	SI38AA	1.55E-04	-	SI38 PATH A - SI38 PATH A			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
31	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.97E-11	0.26
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	SI38AA	1.55E-04	-	SI38 PATH A - SI38 PATH A			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
32	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.95E-11	0.26
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	SI38CA	1.55E-04	-	SI38 PATH C - SI38 PATH C - SI38A=S, SI38B=S			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
33	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.95E-11	0.26
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	SI38CA	1.55E-04	-	SI38 PATH C - SI38 PATH C - SI38A=S, SI38B=S			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
34	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.94E-11	0.26
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	SI38CA	1.55E-04	-	SI38 PATH C - SI38 PATH C - SI38A=S, SI38B=S			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
35	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.94E-11	0.26
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	SI38CA	1.55E-04	-	SI38 PATH C - SI38 PATH C - SI38A=S, SI38B=S			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
36	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	7.86E-11	0.26
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	SI38BA	1.56E-04	-	SI38 PATH B - SI38 PATH B - SI38A=S			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
37	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.74E-11	0.22
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS8AC	1.31E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
38	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.74E-11	0.22
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS8AC	1.31E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AC SUPPORT AVAILABLE			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
39	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.74E-11	0.22
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS8AC	1.31E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
40	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.74E-11	0.22
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS8AC	1.31E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
41	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS8AB	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
42	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS8AB	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
43	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS8AB	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
44	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS8AB	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
45	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS8AE	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
46	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS8AE	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
47	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS8AE	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
48	MLOCA	3.05E-04	Medium LOCA		MELTSUMP	6.69E-11	0.22
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS8AE	1.30E-04	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSNO: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	SUMPZ	1.00E+00	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING - ALL OTHER PUMP STATES			
49	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.13E-11	0.20
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
50	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.13E-11	0.20
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
51	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.13E-11	0.20
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
52	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
53	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
54	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
55	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
56	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
57	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
58	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
59	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
60	LLOCA	5.20E-06	Large LOCA		MELTSUMP	6.12E-11	0.20
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
61	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
62	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
63	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
64	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
65	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
66	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEECA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 3, LH, HH, CS, SICOM			
	PBZ	1.00E+00	-	SI COMMON TRAIN B - GUARANTEED FAILED			
	HBZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	LBZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN B - GUARANTEED FAILED			
	CS3AC	9.91E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAC: CSS TRAIN AC SUPPORT AVAILABLE			
	RBZ	1.00E+00	-	SI RECIRCULATION TRAIN B - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
67	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
68	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
69	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEEBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 3, LH, HH, CS, SICOM			
	PAZ	1.00E+00	-	SI COMMON TRAIN A - GUARANTEED FAILED			
	HAZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	LAZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN A - GUARANTEED FAILED			
	CS4AB	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSBC: CSS TRAIN BC SUPPORT AVAILABLE			
	RAZ	1.00E+00	-	SI RECIRCULATION TRAIN A - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
70	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
71	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
72	LLOCA	5.20E-06	Large LOCA		MELTSUMP	5.38E-11	0.18
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEEAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 3, LH, HH, CS, SICOM			
	PZZ	1.00E+00	-	SI COMMON TRAIN C - GUARANTEED FAILED			
	HCZ	1.00E+00	-	HIGH HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	LCZ	1.00E+00	-	LOW HEAD SAFETY INJECTION TRAIN C - GUARANTEED FAILED			
	CS2AE	9.92E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSAB: CSS TRAIN AB SUPPORT AVAILABLE			
	RCZ	1.00E+00	-	SI RECIRCULATION TRAIN C - GUARANTEED FAILED			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL22	6.19E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 22, LARGE LOCA			
73	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEFCA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
74	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEFBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
75	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMEFAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
76	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TIMEG	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train D - TDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
77	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEFCA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
78	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEFCA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
79	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEFCA	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
80	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEFBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
81	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMEFAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - MDAFW, SGPORV			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
82	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TIMEG	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train D - TDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
83	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEFAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
84	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMEFBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
85	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TIMEG	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train D - TDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
86	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEFBC	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
87	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMEFAB	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - MDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
88	LLOCA	5.20E-06	Large LOCA		MELTSUMP	2.92E-11	0.10
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	TIMEG	7.50E-03	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train D - TDAFW, SGPORV			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	SULL1	3.40E-03	-	SUMP STRAINER DURING RECIRCULATION - SUMP PLUGGING STATE 1, LARGE LOCA			
89	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
90	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
91	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSD	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP D			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
92	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
93	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
94	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSC	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP C			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
95	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
96	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
97	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMECCA	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train B - Case 1, EW, CC, DG, CH, RH, RCFC			
	WBZ	1.00E+00	-	ECW TRAIN B - GUARANTEED FAILED			
	ECBZ	1.00E+00	-	ECH TRAIN B - GUARANTEED FAILED			
	KBZ	1.00E+00	-	CCW TRAIN B - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
98	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
99	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSA	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP A			
	TMECAB	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train C - Case 1, EW, CC, DG, CH, RH, RCFC, CVA			
	WCZ	1.00E+00	-	ECW TRAIN C - GUARANTEED FAILED			
	ECCZ	1.00E+00	-	ECH TRAIN C - GUARANTEED FAILED			
	KCZ	1.00E+00	-	CCW TRAIN C - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			

Top 100 Sequences Involving GSI-191 Phenomenon (Continued)

Rank	IE/SF	Value	IE	Top Event - Split Fraction Description	Group	Seq Freq.	% of Group
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			
100	LLOCA	5.20E-06	Large LOCA		MELTBORON	2.24E-11	0.07
	BRKSB	2.50E-01	-	RCS LOOP BREAK FRACTION - BREAK IN LOOP B			
	TMECBC	1.53E-02	-	GENERIC PLANNED MAINTENANCE - Planned Maint Train A - Case 1, EW, CC, DG, CH, RH, RCFC, CVB			
	WAZ	1.00E+00	-	ECW TRAIN A - GUARANTEED FAILED			
	ECAZ	1.00E+00	-	ECH TRAIN A - GUARANTEED FAILED			
	KAZ	1.00E+00	-	CCW TRAIN A - GUARANTEED FAILED			
	CS1AA	9.87E-01	-	CONTAINMENT SPRAY - RECIRCULATION - State: CSABC: CSS TRAIN ABC SUPPORT AVAILABLE			
	OS1Z	1.00E+00	-	OPERATORS SECURE 1 OF 3 RUNNING SPRAY TRAINS			
	OFFSZ	1.00E+00	-	OPERATORS SECURE ALL CONTAINMENT SPRAY FOR LATE RECIRCULATION			
	BLL1S	1.25E-03	-	BORON PRECIPITATION FOLLOWING SUMP RECIRCULATION - LLOCA, PUMP STATE 1, HLEG=S, WITH GSI-191 ISSUES			

Total Quantified Frequency of Sequence Group = 3.0705E-008

APLAB, Results Interpretation – Uncertainty Analysis: RAI 2

Volume 3, Assumption 3.a (page 76 of 248) states that the geometric-mean aggregation of LOCA frequencies in NUREG-1829 is the most appropriate set of results to use for this evaluation. The basis provided is that geometric-mean aggregation produces frequency estimates that are approximately the same as the median estimates of the panelists. There is no justification about why the median estimate is preferred and emphasis on the median conflicts with the RG 1.174 guidance that the mean values be used for decision-making. Furthermore, information in NUREG-1829, Section 7.6.4, "Aggregation," shows that the use of the arithmetic mean instead of the geometric mean would increase the LOCA frequency by an order of magnitude or more for some LOCA categories and may therefore substantially increase the risk estimates. Consequently, selection of the geometric mean is a key assumption and selection of the arithmetic mean represents an alternative reasonable assumption as defined by RG 1.200. This is supported by RG 1.174, Section 2.5, "Comparison of Probabilistic Risk Assessment Results with the Acceptance Guidelines," which states, in part, that "the licensee should [identify] key assumptions in the PRA that impact the application." Sensitivity studies provide important information about how some of the key assumptions affect the final results as discussed in RG 1.174 Section 2.5.3. Please provide CDF, LERF, ΔCDF, and ΔLERF using the arithmetic mean aggregation of LOCA frequencies in NUREG-1829.

STP Response:

The choice of geometric mean values from the expert elicitation was the model that most closely follows the risk-informed methodology in which parameters and models that represent realistic behavior are selected, as opposed to those that would be selected in other settings such as a deterministic framework in which the most pessimistic models would be selected. The technical justification is provided in the white paper included as Enclosure 2 where it is shown how the arithmetic mean emphasizes extreme values in the LOCA frequency setting.

Further justification is provided in NUREG 1829 where it is recommended that the selection of the frequency model should be appropriate for the application (page xxii) and where it is noted that alternative aggregation methods can lead to significantly different results. The authors of NUREG 1829 go on to say that a particular set of LOCA frequency estimates is not generically recommended for all risk-informed applications and that the purposes and context of the application must be considered when determining the appropriateness of any set of elicitation results. Because the maximum amount of debris would be created in the largest hypothesized LOCA categories, it is particularly appropriate that the risk-informed approach adopt the model that would produce the most likely center frequencies (and concomitant uncertainty).