NRR-PMDAPEm Resource

From: Harrison Albon [awharrison@STPEGS.COM]
Sent: Monday, December 01, 2014 7:00 AM
To: Singal, Balwant; Lyon, Fred
Subject: Fwd: Ernie's slides
Attachments: 14SI008 Sldes.pdf; ATT00001.htm

Balwant, Fred,

This is the other STP presentation.

Note that we are bringing 25 copies of both presentations with us to the meeting.

Regards,
Wayne Harrison
979-292-6413

Begin forwarded message:

From: "Kee, Ernie" <keeej@STPEGS.COM<mailto:keeej@STPEGS.COM>>
To: "Harrison Albon" <awharrison@STPEGS.COM<mailto:awharrison@STPEGS.COM>>
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Hearing Identifier: NRR_PMDA
Email Number: 1758

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Subject: Fwd: Ernie's slides
Sent Date: 12/1/2014 6:59:58 AM
Received Date: 12/1/2014 7:00:07 AM
From: Harrison Albon

Created By: awharrison@STPEGS.COM

Recipients:
"Singal, Balwant" <Balwant.Singal@nrc.gov>
Tracking Status: None
"Lyon, Fred" <Fred.Lyon@nrc.gov>
Tracking Status: None

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MESSAGE	518	12/1/2014 7:00:07 AM
14SI008 Sldes.pdf	1504181	
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Priority: Standard
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Bounding Debris Approach:

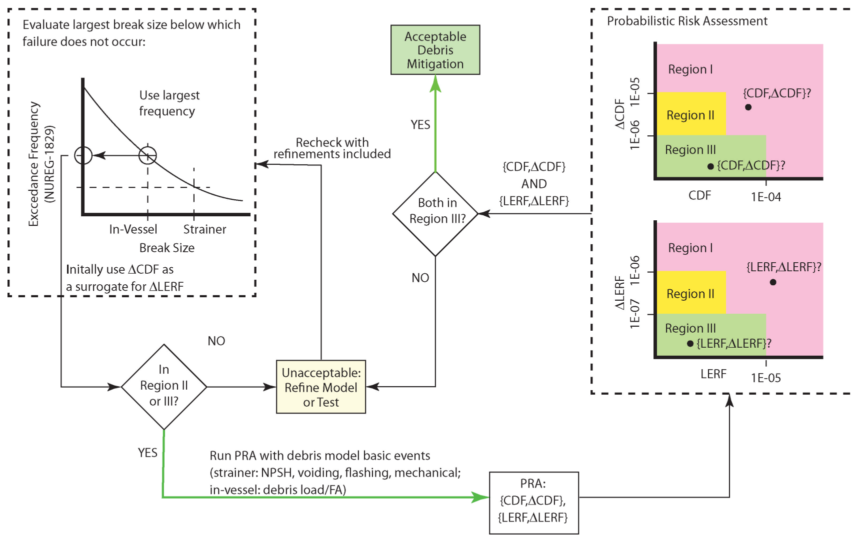
STPNOC NRC Public Meeting
01 December – 03 December 2014

Summary

1. Use STPNOC 2008 validated test data to bound the LAR risk evaluation
2. Scale the test data to the current ZOI requirements
3. Show the scaled test data indicate adequate strainer performance at break sizes that have corresponding exceedance frequency in Region II or III (assume core damage frequency is the exceedance frequency at the break size)
4. Show the frequency for the largest break size below which failure in-vessel (core fiber loading) occurs is also in Region II or Region III (referred to as ‘simulation’)
5. The scaled frequencies for different interpolation methods are shown to be low in Region II (at the boundary of Region III)

Concept

1. Use results of previous strainer testing (performed in July 2008) to find the largest break size below which strainer failure does not occur
   - Check if the break size is greater than the largest break size below which in-vessel failure occurs (i.e., 7.5 gm/FA)
   - Use the smallest of the two break sizes to check CDF against NUREG 1829 exceedance frequencies
   - Ensure the exceedance frequency for the smallest break size is in Region II or III of RG 1.174
2. Using the PRA, ensure the risk $\{CDF, \Delta CDF\}$, $\{LERF, \Delta LERF\}$ for breaks above the smaller of the two break sizes (in-vessel or strainer) is in Region III of RG 1.174
3. If either the exceedance frequency from the initial screen fails to be in Region II OR the Probabilistic Risk Assessment is not in Region III, the results are unacceptable
4. Otherwise the evaluation of the debris risk is acceptable as long as the other requirements of RG 1.174 are met


Evaluate largest break size below which failure does not occur:
Exceedance Frequency (NUREG-1829)
Use largest frequency
In-Vessel
Strainer
Break Size
Initally use ΔCDF as a surrogate for ΔLERF
Recheck with refinements included
Acceptable Debris Mitigation
YES
Both in Region III?
NO
{CDF,ΔCDF} AND {LERF,ΔLERF}
Probabilistic Risk Assessment
Region I
Region II
Region III
{CDF,ΔCDF}?
ΔCDF
1E-06
1E-05
CDF
1E-04
{LERF,ΔLERF}?
ΔLERF
1E-07
1E-06
LERF
1E-05
NO
In Region II or III?
Unacceptable: Refine Model or Test
YES
Run PRA with debris model basic events (strainer: NPSH, voiding, flashing, mechanical; in-vessel: debris load/FA)
PRA: {CDF,ΔCDF}, {LERF,ΔLERF}

Volume scaling – 2008 strainer test

Although a 5D break would be a single-sided break (that is, half the volume of a DEGB), assume spherical volume and compute the equivalent break size (nominally $\frac{5}{17}D$, see what follows) at the 2008 worst case break location that would produce the same amount of fine debris as that which was assumed in the 2008 test. Because the 2008 test used a different fines size distribution than that used in the LAR, the more conservative fines generation amount (ignoring the factor of two) will be used as the basis. That is, if the 2008 testing assumption was more conservative than the LAR, then use a 5D assumption, otherwise, the break needs further scaling to account for missing fines. As shown in what follows, the 2008 fines distribution was more conservative (although effectively equivalent) than the LAR methodology.

Fines distribution from different methods

- The 2008 test (AREVA, 2008) used two ZOIs, 7D and 5D. In the 7D to 5D ZOI, all the debris was assumed to be large pieces. In the 5D ZOI, 30% of 60% of the debris (that is, 18% of debris) was assumed to be fines.
- The LAR uses three shells with different fines distributions as summarized in the table below. The 2008 method is more conservative (greater amount of fines produced in the ZOI).
- In order to preserve the same amount of fiber as was tested in 2008, 5D is used as the basis for scaling.

Volume scaling using 5D as a basis

$$V = \frac{4}{3}\pi r^3, \tag{1a}$$

$$V = \cancel{\frac{4}{3}\pi}\left\{(5)(29in)\right\}^3 = \cancel{\frac{4}{3}\pi}\left\{(17)(Xin)\right\}^3, \tag{1b}$$

$$\left\{(5)(29in)\right\}^3 = \left\{(17)(X)\right\}^3, \tag{1c}$$

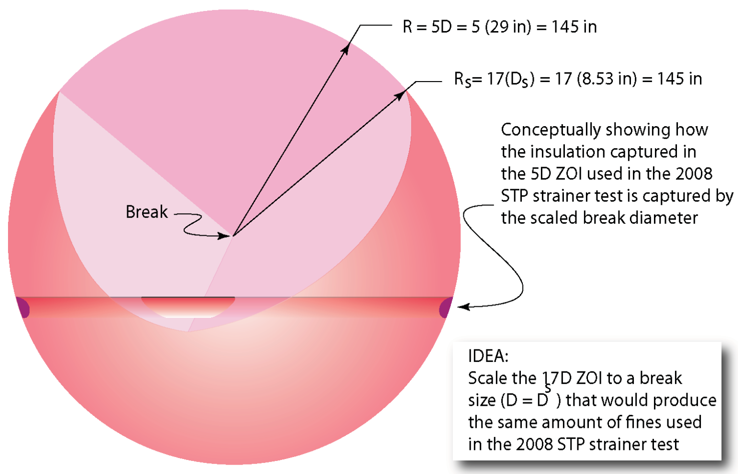
$$\sqrt[3]{\left\{(5)(29in)\right\}^3} = \sqrt[3]{\left\{(17)(X)\right\}^3}, \tag{1d}$$

$$(5)(29in) = (17)(X), \tag{1e}$$

$$X = \frac{5}{17}(29in), \tag{1f}$$

$$X = 8.53in. \tag{1g}$$

5D ZOI scaling produces the same amount of fines



Looking up the exceedance frequency

The initial ΔCDF used is for the exceedance frequency associated with the equivalent break size (8.53 in) determined for the 5D ZOI. The values from NUREG-1829 (repeated in here below) are used.

Table: NUREG-1829 (Tregoning et al., 2008, Table 7.19) for the mean, median, 5th percentile, and 95th percentile exceedance frequency values for current-day estimates

		NUREG-1829 Values			
Category	Break Size	**5th**	**Median**	**Mean**	**95th**
cat_1	$\frac{1}{2}$	6.80E-05	6.30E-04	1.90E-03	7.10E-03
cat_2	$1\frac{5}{8}$	5.00E-06	8.90E-05	4.20E-04	1.60E-03
cat_3	3	2.10E-07	3.40E-06	1.60E-05	6.10E-05
cat_4	7	1.40E-08	3.10E-07	1.60E-06	6.10E-06
cat_5	14	4.10E-10	1.20E-08	2.00E-07	5.80E-07
cat_6	31	3.50E-11	1.20E-09	2.90E-08	8.10E-08

Looking up the exceedance frequency

Table: The CDF obtained if failures above the Break Size are assumed to go to failure and those below are success. Break Size data comes from simulation and test and the frequency data (CDF) from (Tregoning et al., 2008, Table 1, page xxi). Note that the in-vessel results, 7.34 inches (STPNOC, 2014, Attachment 1, page 37, APLAB RAI 2b), are included since both the strainer and core need to be considered.

Source	Break Size	Interpolation Method	CDF
Test	8.53	Log-Linear	1.02E-06
Test	8.53	Linear-linear	1.29E-06
Simulation	7.34	Log-Linear	1.45E-06
Simulation	7.34	Linear-linear	1.53E-06

Looking up the exceedance frequency

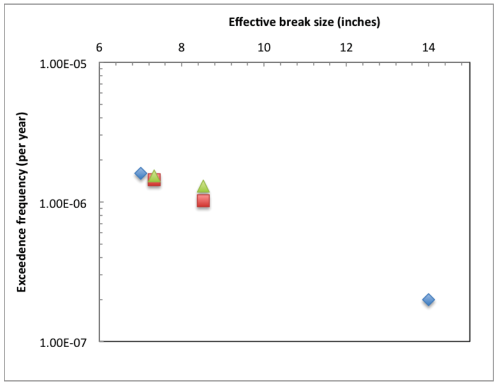


Figure: Data for 7 inch and 14 inch equivalent break sizes from (Tregoning et al., 2008, Table 1, page xxi) (diamonds) shown with log-linear interpolated data (squares) and linear data interpolation (triangles) for the equivalent simulated and test break sizes 7.34 inches and 8.53 inches.

References

AREVA (2008, August). South Texas Project Test Report for ECCS Strainer Testing. AREVA NP Document 66-9088089-000, AREVA NP, 7207 IBM Drive, Charlotte, NC 28262.

STPNOC (2014, July). South Texas Project Units 1&2 Docket Nos. STN 50-498, STN 50-499 Third Set of Responses to April, 2014, Requests for Additional Information Regarding STP Risk-Informed GSI-191 Licensing Application (TAC NOs MF2400 and MF2401). STP LTR NOC-AE-14003105/STI32407300, ML14202A045, NRC Public Document Room.

Tregoning, R., L. Abramson, and P. Scott (2008, April). Estimating Loss-of-Coolant Accident (LOCA) Frequencies Through the Elicitation Process. NUREG/CR 1829, Nuclear Regulatory Commission, Washington, DC.