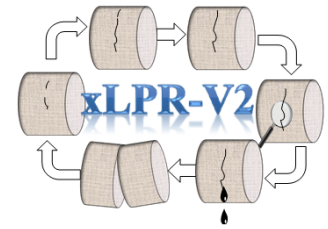


# Extremely Low Probability of Rupture (xLPR) Project

-- Inputs --

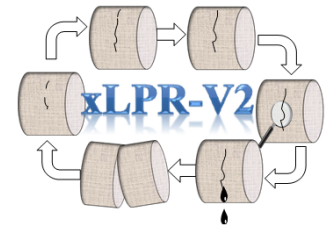
Gary L. Stevens  
Senior Materials Engineer  
RES/DE/CIB

xLPR External Review Board Meeting  
February 20, 2013



# Contents

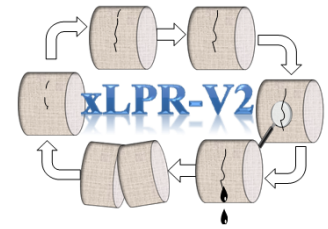
- 1. Selection of weld locations for Version 2.0**
- 2. Identification of Input Parameters**
  - a. Inputs Spreadsheet**
  - b. Attributes and Valid Ranges**
  - c. Material property Database development**
  - d. Collection of Input Values**
    - i. Plant Data
    - ii. Vendor Data
    - iii. Consensus Data
  - e. Inputs GUI**



# Selection of Weld locations

- **Two sample plants were selected for evaluation under the Version 2.0 Project**
  - **Westinghouse Sample Plant = 4-loop plant, Reactor Coolant Loop and branch lines > 6" nominal**
  - **B&W Sample Plant = Reactor Coolant System hot leg and cold leg piping**
- **Weld Selection Criteria:**
  - **The welds are limited to those from LBB piping systems**
  - **The welds are limited to those fabricated with material susceptible to PWSCC (i.e., nickel-based alloy welds)**
  - **The welds are limited to those from one of the two sample plants**

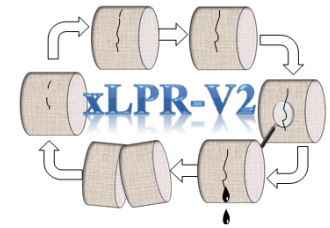
# Selection of Weld locations (cont.)



- **Welds Selected from Westinghouse Plant (2):**
  - Hot-leg/RPV Nozzle Weld
  - SG Hot-leg Nozzle Weld to Hot-leg Elbow
  - Rationale for selection documented in “**Westinghouse-plant-welds-FINAL.docx**”
  - For picture, see Additional Info. Slides at end
- **Weld Selected from B&W Plant (1):**
  - Lower Cold Leg/Pump
  - Rationale for selection documented in “**BW-plant-welds-FINAL.docx**”
  - For picture, see Additional Info. Slides at end

# Identification of Input Parameters

## Inputs Spreadsheet



### K-SOLUTION Module Inputs Used by xLPR Version 2.0

Reviewed by:

K-SOLUTION Subgroup Lead

Source:

Last Revised:

Monday, January 28, 2013

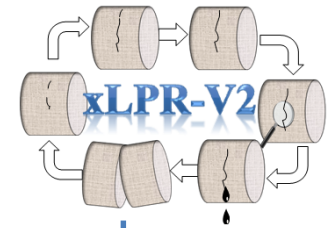
Mike Benson

ADDED

Input No.	Input Variable Name (as used in Source Code)	Framework Location and Name	Input Description	Module(s) Where Input is Used (SELECT FROM DROP-DOWN MENU)	Is This Input a User Input, or is it passed from another Module? (SELECT FROM DROP- DOWN MENU)	Input Engineering Units	Input Uncertainty Type (Aleatory or Epistemic) (SELECT FROM DROP- DOWN MENU)	Range of Validity for This Input	Who Will Collect This Input Variable?	Input Definitions	Default, Generic or Basecase Value
1	Ri	Pipe_Geometry Inside_Radius	Pipe inside radius. Used in both part through-wall crack subroutine and through-wall crack subroutine.	K-SOLUTION	User Input	m	Constant	$2 \leq Ri/t \leq 20$		Value	
2	t	Pipe_Geometry Pipe_Thickness	Pipe wall thickness. Used in both part through-wall crack subroutine and through-wall crack subroutine.	K-SOLUTION	User Input	m	Constant	$2 \leq Ri/t \leq 20$		Value	
3	a	State_variables Grow_depth	Crack depth. Used in part through-wall crack subroutine only.	K-SOLUTION	Calculated in the Crack Growth Module	m	Epistemic	$0 < a/t \leq 0.9$ for part through-wall cracks		Distribution Type Parameter 1 Parameter 2 Parameter 3 Lower Trunc. Upper Trunc. Correlation? List of Correlations	Defined in the Crack Growth Module
4	c		Half crack length. Used in both part through-wall crack subroutine and through-wall crack subroutine.	K-SOLUTION	Calculated in the Crack Growth Module	m	Epistemic	Unknown yet, but will have to be specified		Distribution Type Parameter 1 Parameter 2 Parameter 3 Lower Trunc. Upper Trunc. Correlation? List of Correlations	Defined in the Crack Growth Module

# Identification of Input Parameters

## Attributes and Valid Ranges

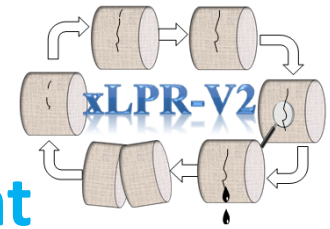


### K-SOLUTION Module Inputs Used by xLPR Version 2.0

Reviewed by: K-SOLUTION Subgroup Lead  
 Source:  
 Last Revised: Monday, January 28, 2013 Mike Benson

Input No.	Input Variable Name (as used in Source Code)	Framework Location and Name	Input Description	Module(s) Where Input is Used (SELECT FROM DROP-DOWN MENU)	Is This Input a User Input, or is it passed from another Module? (SELECT FROM DROP- DOWN MENU)	Input Engineering Units	Input Uncertainty Type (Aleatory or Epistemic) (SELECT FROM DROP- DOWN MENU)	Range of Validity for This Input	Who Will Collec This Input Variable?	Input Definitions	Default, Generic or Basecase Value
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# Identification of Input Parameters

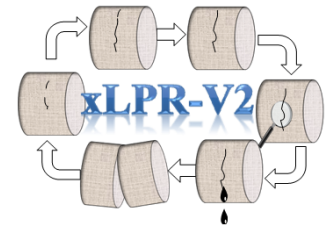


## Material Property Database Development

- xLPR “Inputs Library” will contain default material properties
- NRC has begun to assemble available data from PIPEFRAC database
- Using Uncertainty Spreadsheet Tool to establish uncertainties
- Requested additional available data from EMC<sup>2</sup>
- Requested additional available data from Japan
- Progress on-going

# Identification of Input Parameters

## Collection of Input Values

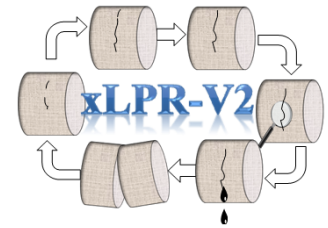


- **Plant Inputs:**
  - So far, this has been limited to weld details (fab. records, etc.)
  - Other inputs from the plant not envisioned at this time
- **Vendor Data:**
  - Westinghouse and Areva are providing weld geometry and design details
    - See “[Westinghouse 4-Loop RPV Inlet-Outlet Nozzle Inputs \(MCOE-LTR-12-63\).pdf](#)”
    - Areva Letter available
  - Other Vendor Data TBD


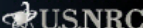


# Identification of Input Parameters

## Input GUI (by GOLDSIM)



xLPR Framework Model version 2.0 – Pilot Study Problem

GEOMETRY DASHBOARD  

**Pipe Size** ☐ User-defined pipe geometry NPS 4 SCH 40s/40

Outer Diameter (mm): 114.3 mm Wall Thickness (mm): 6.02 mm

**Weld Type**

User-Defined Weld

Base Material 1: A508GB Base Material 2: A600 Weld Material: SS364

**Mitigation During Operation**

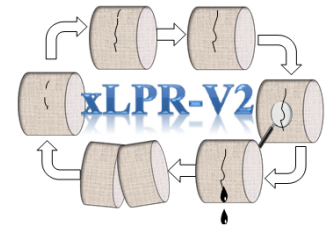
☒ Include mitigation in simulation [Go to Mitigation Settings](#)

[Home Dashboard](#)

[Reactor Chemistry >>](#)

[<< Inspection / Leak Detection](#)

# Additional Info. Slides

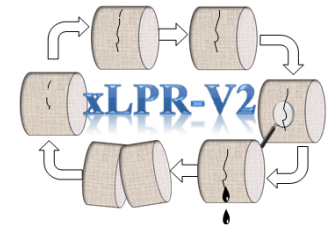


3 slides attached

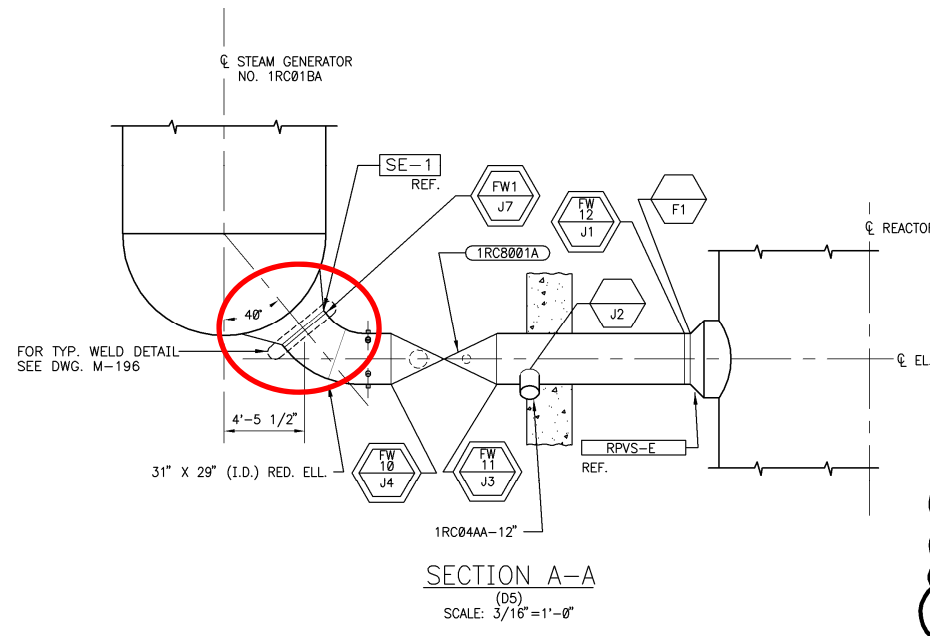
The diagram illustrates the xLPR-V2 architecture. It features a central blue label 'xLPR-V2' with a reflection effect. Surrounding this label are six cylindrical blocks, each with a textured, brown surface. These blocks are arranged in a circular flow, connected by curved arrows indicating a clockwise sequence. The top-left block has a vertical crack. The top-right block has a small circular hole. The bottom-right block has a vertical crack and a single drop of oil falling from its base. The bottom-left block is split horizontally. The leftmost block has a vertical crack. The entire diagram is set against a white background.

2<sup>nd</sup>

# Westinghouse Plant Weld #2



Site Identification Code U from Draft NUREG-1903  
Hot-leg to SG elbow to pump



The diagram illustrates the xLPR-V2 architecture. It features a central blue label 'xLPR-V2' with a reflection effect. Surrounding this label are six cylindrical blocks, each with a textured, brown surface. These blocks are arranged in a circular flow, connected by curved arrows indicating a clockwise sequence. The top-left block has a vertical crack. The top-right block has a small circular hole. The bottom-right block has a vertical crack and a single drop of oil falling from its base. The bottom-left block is split horizontally. The leftmost block has a vertical crack. The entire diagram is set against a white background.

