

LaSalle County  
Generating Station  
Pre-Application Meeting  
Extended Power Uprate

Replacement Steam Dryers

**June 11, 2012**

## **Purpose:**

Provide the basis for designating LaSalle Units 1 and 2, Peach Bottom Unit 3 replacement steam dryers as non-prototype category 1 (RG 1.20)

Define the approach for signal processing main steam line strain gauge data

## **Agenda:**

- **Replacement Steam Dryer (RSD) Licensing Approach**
- **Basis for Designating LaSalle Units 1 and 2, Peach Bottom Unit 3 RSDs Non-prototype Category 1**
- **Signal Processing Main Steam Line Strain Gauge Data**
- **Contingency Session:**  
Proprietary Closed Session for NRC Questions

# Replacement Steam Dryer Licensing Approach

## ✓ Regulatory Requirement and Guidance

- GDC-1
- RG 1.20
- RS-001
- SRP 3.9.1, 3.9.2 and 3.9.5

Steam dryer performs no safety functions but must retain its structural integrity (SRP 3.9.5)

## ✓ RG 1.20 Classification Strategy

- Peach Bottom Unit 2 designated as prototype
- Subsequent units designated non-prototype, category I since they are substantially the same as Peach Bottom Unit 2
  - LaSalle Unit 1 and Unit 2
  - Peach Bottom Unit 3

- ✓ RSDs have substantially the same arrangement, design, size, and operating conditions as Peach Bottom Unit 2
- ✓ Unit specific subscale testing is being performed
- ✓ Unit specific acoustic circuit modeling and structural analysis will be performed
  - Acoustic Circuit Model (ACM) 4.1 to be utilized
  - Minimum alternating stress ratio  $> 2.0$  at EPU
- ✓ Vibration measurement program using Main Steam Line (MSL) strain gauges will be performed
- ✓ Unit specific power ascension plans and power ascension limit curves will be generated
- ✓ RSD inspections will be conducted as part of normal reactor vessel internals inspection program and will focus on accessible welds at critical locations

**Basis for Designating LaSalle Units 1 & 2  
And Peach Bottom Unit 3 RSDs  
Non-Prototype Category 1**

- ✓ Evaluate nominal differences between non-prototype and prototype dryers consistent with RG 1.20 Rev.3
  - Attributes critical to maintaining the structural integrity of the dryer
    - Dryer Design
    - Vessel Geometry and Vessel Interface with Dryer
    - Operating Conditions
    - Acoustic Excitation and Dynamic Loading
  - Identify and evaluate differences in critical attributes between prototype and non-prototype dryers
    - Tables 1 – 4
- Demonstrate that differences between prototype and non-prototype dryers have no significant effect on vibratory response and excitation of the dryers. Specifically, the RSDs will be shown to maintain their structural integrity

**Table1 COMPARISON OF KEY STEAM DRYER DESIGN PARAMETERS BETWEEN PROTOTYPE AND NON-PROTOTYPE DRYERS**

			Peach Bottom 2	Peach Bottom 3	LaSalle 1	LaSalle 2
Dryer Diameter			245 in	245 in	245 in	245 in
Dryer Height [nominal]			203 in	203 in	203 in	203 in
Dryer Configuration			3-ring octagonal	3-ring octagonal	3-ring octagonal	3-ring octagonal
Instrumentation Mast and Brackets			Included	Not Included	Not Included	Not Included
Hold-down Rods and Brackets			Included	Not Included	Not Included	Not Included
Perforated Plate Design			Same	Same	Same	Same
All other steam dryer structural components			Same	Same	Same	Same



- The design, material selection and construction of all four replacement steam dryers are substantially similar and all dryers will be subjected to identical manufacturing testing and examinations
- Differences at reactor vessel interfaces reflect unit specific vessel design features
  - Dryer hold-down brackets (RPV head stops)
  - Instrument mast installed for prototype dryer during first cycle of operation
- Differences identified will not impact structural integrity of dryer and will be included in the unit specific structural analysis
- The dryers will be of the substantially similar design, materials and construction from the same supplier. Any nominal dryer design differences between prototype and non-prototype dryers will be evaluated to ensure no significant effect on vibratory response and excitation of the dryers

**Table 2 COMPARISON OF KEY REACTOR VESSEL GEOMETRY/VESSEL INTERFACE PARAMETERS BETWEEN PROTOTYPE AND NON-PROTOTYPE DRYERS**

			Peach Bottom 2	Peach Bottom 3	LaSalle 1	LaSalle 2
Vessel Inside Diameter [nominal]			251 in.	251 in.	251 in.	251 in.
Steam Volume Used in Acoustic Model of the Steam Dome			7,565 ft <sup>3</sup>	7,565 ft <sup>3</sup>	7,477 ft <sup>3</sup>	7,477 ft <sup>3</sup>
Vessel Shape (angles between Main Steam Line Pipes)			36° between same side MSLs at 72°, 108°, 252° and 288°	36° between same side MSLs at 72°, 108°, 252° and 288°	36° between same side MSLs at 72°, 108°, 252° and 288°	36° between same side MSLs at 72°, 108°, 252° and 288°
Vessel Lug Areas			4" x 3"	4" x 3"	5.2" x 3"	5" x 3"
Radial Distance from outside of skirt to RPV ID			3 in	3 in	4.2 in	4.0 in

- Differences exist in steam volumes used in the acoustic model due to differences in steam dome height dimensions and normal water levels
- Steam dome/vessel dimensional differences are scaled in subscale testing
- Differences in vessel geometry/interfaces are evaluated by unit specific:
  - MSL Excitation Data
  - Subscale testing
  - Signal Processing
  - ACM load definition
  - Structural Analysis
  - Limit Curve Determination
- Unit specific vessel lug analyses will be performed
- The nominal vessel geometry and vessel interface differences between prototype and non-prototype dryers will be evaluated in unit specific analysis to ensure no significant effect on vibratory response or excitation of the dryers

**Table 3: COMPARISON OF OPERATING CONDITIONS PARAMETERS BETWEEN PROTOTYPE AND NON-PROTOTYPE DRYERS**

			Peach Bottom 2	Peach Bottom 3	LaSalle 1	LaSalle 2
Power Level			3952 MWt	3952 MWt	3988 MWt	3988 MWt
Steam Flow Rate			16.2 Mlbm /hr	16.2 Mlbm /hr	17.61 Mlbm /hr	17.61 Mlbm /hr
MSL Steam Velocity			155 Ft/sec	155 Ft/sec	169 Ft/sec	169 Ft/sec
Steam Quality			99.99%	99.99%	99.99%	99.99%
Steam Temperature [nominal]			550 °F	550 °F	550°F	550°F
Steam Pressure			1050 psia	1050 psia	1020 psia	1020 psia

*Note: Design analyses performed at 1.02 EPU conditions*

- Differences in operating conditions include steam flows and pressure
- Differences in operating conditions are evaluated by unit specific:
  - MSL Excitation Data
  - Subscale testing
  - Signal Processing
  - ACM load definition
  - Structural Analysis
  - Limit Curve Determination
- The nominal operating condition differences between prototype and non-prototype dryers will be evaluated in unit specific analysis to ensure no significant effect on vibratory response or excitation of the dryers

**Table 4 COMPARISON OF ACOUSTIC EXCITATION AND DYNAMIC LOADING PARAMETERS BETWEEN PROTOTYPE AND NON-PROTOTYPE DRYERS**

			Peach Bottom 2	Peach Bottom 3	LaSalle 1	LaSalle 2
MSL Diameter			26" OD, RPV to TSV ID is 23.724" RPV to inboard MSIV, 23.864" inboard MSIV to TSV	26" OD, RPV to TSV ID is 23.724" RPV to inboard MSIV, 23.864" inboard MSIV to TSV	26" OD, RPV to Equalizer 24.1" ID, RPV to MSIV	26" OD, RPV to Equalizer 24.1" ID, RPV to MSIV
Length – RPV to first sidebranch [nominal]			55 ft	55 ft	43 ft	43 ft
Blank Standpipe internal diameter			5.19 in	5.19 in	6.81 in	6.81 in
Blank Standpipe internal height			19.64 in	19.64 in	15.95 in	15.95 in
Blank Standpipe Single Vortex Predicted Onset Velocity			261 ft/sec	261 ft/sec	381 ft/sec	381 ft/sec
Sweeplet Radius			0.75 in	0.75 in	0.75 in	0.75 in
SRV sidebranch internal diameter [nominal]			Dresser = 5 in Target Rock = 6 in	Dresser = 5 in Target Rock = 6 in	Crosby = 5 in	Crosby = 5 in
SRV sidebranch internal height			Dresser = 34.7 in Target Rock = 38.5 in	Dresser = 34.7 in Target Rock = 38.5 in	23.8 in	23.8 in
Dead-ended legs			Yes (MSLs B & C)	Yes (MSLs B & C)	No	No
SRV Standpipe Single Vortex Predicted Onset Velocity			Dresser = 151 ft/sec Target Rock = 120 ft/sec	Dresser = 151 ft/sec Target Rock = 120 ft/sec	312 ft/sec	312 ft/sec
MSL Flow Restrictors			Yes	Yes	Yes	Yes
Equalizer Assembly			TSV connection	TSV connection	TSV connection and D-Ring	TSV connection and D-Ring

- Acoustic phenomena predicted at
  - Peach Bottom: Target Rock, Dresser and Blank Standpipes
  - LaSalle: Crosby and Blank Standpipes
- Differences in acoustic excitation evaluated by unit specific
  - MSL Excitation Data
  - Subscale testing
  - Signal Processing
  - ACM load definition
  - Structural analysis
  - Limit curve determination
- The nominal acoustic excitation and dynamic loading differences between prototype and non-prototype dryers will be evaluated in unit specific analysis to ensure no significant effect on vibratory response or excitation of the dryers

- LaSalle 1 & 2 and Peach Bottom 3 nominal differences from the prototype RSD have been identified and evaluated to assess the impact on dryer structural integrity
- It will be demonstrated through design, testing and analysis that the nominal differences have no significant effect on the vibratory response and excitation of the steam dryers
- Appropriate to classify LaSalle 1 & 2 and Peach Bottom 3 as non-prototype category I RSDs in accordance with RG 1.20 Rev. 3



# Signal Processing Main Steam Line Strain Gauge Data

- Signal Processing Approach for Steam Dryer High Cycle Fatigue Evaluation
  - Identical to QDC ACM 4.1 benchmarking
  - Identical to approach utilized for NMP2 EPU approval
  - Data reduction details to be provided in WCAP report which will be included in the LAR submittal
    - Signal noise removed from data
      - EMF energy (60, 120, 180 and 240Hz) filtered when present in data
      - Extraneous non-identified electrical sources as determined by an examination of EIC response filtered when present in data
      - Recirculation vane passing frequencies are filtered when present in data
      - Coherence filtering applied to the two measurements on each main steam line

# Contingency Closed Session

Meeting Close

- ACM – Acoustic Circuit Model
- ASME – American Society of Mechanical Engineers
- BWRVIP – Boiling Water Reactor Vessel Internals Plan
- CLTP – Current Licensed Thermal Power
- ID – Inside Diameter
- EIC – Electrical Interference Check
- EMF – Electromagnetic Frequency
- EPU – Extended Power Uprate
- MSL – Main Steam Line
- LAR – License Amendment Request
- PB – Peach Bottom Atomic Power Station
- RSD – Replacement Steam Dryer
- RS – Review Standard
- QDC – Quad Cities Generating Station
- SR – Stress Ratio
- SRP – Standard Review Plan
- WCAP – Westinghouse Commercial Atomic Power