



Saint Lucie Units 1 and 2 Subsequent License Renewal Application

Pre-Application Meeting #2
June 3rd, 2021



Draft Application Materials **Subject to Change**

Agenda

- Introduction - Topics of Interest
- Surveillance Capsule Removal Schedule
- Irradiation of Concrete – Design and Discussion
- Irradiation of Reactor Pressure Vessel (RPV) Supports – Design and Discussion
- Questions
- Action Items

Surveillance Capsule Removal Schedule

- The next capsule removal for St. Lucie (PSL) Unit 1 is coming up:
 - Table 5.4-3 of the Unit 1 FSAR has the “Approximate Removal Schedule” as 38 Effective Full Power Years (EFPY) for capsule 263
 - However, as part of the SLRA, FPL plans to modify the capsule removal schedule which would push the next Unit 1 capsule removal out to 47 EFPY
- Unit 1 will only be at 37.6 EFPY or less for the next outage (Fall, 2022)
- FPL’s interpretation is the capsule is to be removed at the first refueling outage that meets or exceeds 38 EFPY which would mean the capsule would be removed in the Spring of 2024
 - A similar clarification was made to the Turkey Point and Point Beach surveillance capsule schedules
- With the capsule 263 removal planned for the Spring 2024 outage, there is time to modify the removal schedule via the SLRA

Surveillance Capsule Removal Schedule

- Similar to Turkey Point & Point Beach, an adjustment to the approved withdrawal schedule will allow sufficient material data and dosimetry for the end of the subsequent period of extended operation (SPEO)
- As an example, see the excerpt from Table 4.4-2, Turkey Point UFSAR

| | | | | |
|----------------|------|---------|-------|-----|
| Z ₃ | 230° | Standby | 0.523 | --- |
| Z ₄ | 230° | Standby | 0.523 | --- |

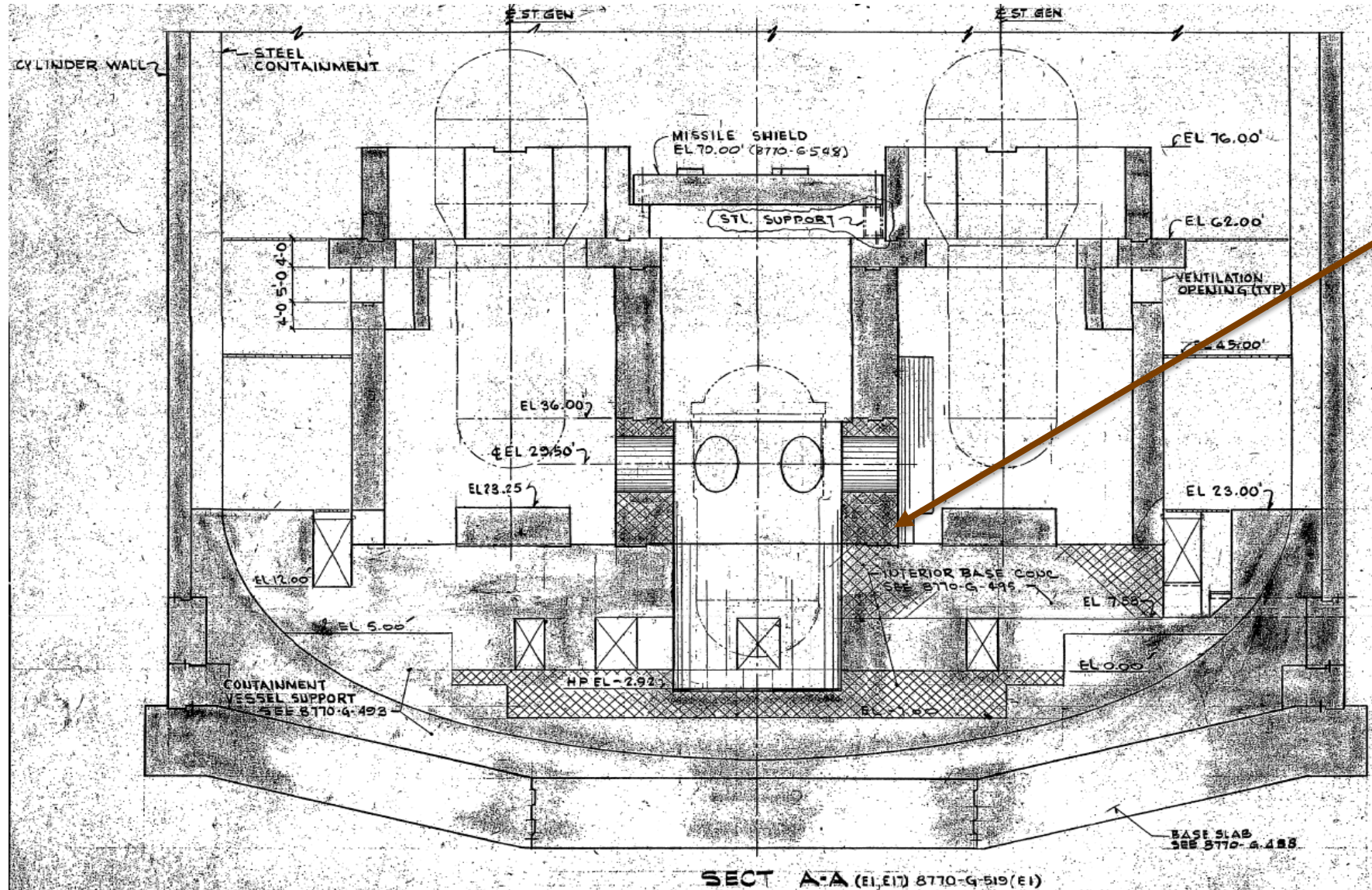
- (a) Capsule X₃ and Capsule X₄ were moved from the 50° location to the 270° location in 1990.
- (b) Effective Full Power Years (EFPY) from plant startup.
- (c) Capsule X₄ should be removed at the first refueling outage that meets or exceeds 41.5 EFPY to fulfill the requirements of the “5th Capsule” to be withdrawn. This EFPY will yield a capsule fluence that is approximately equivalent to the 80-year (72 EFPY) peak vessel fluence of 1.08×10^{20} n/cm² (E > 1.0 MeV).
- (d) The lead factors listed for Capsule x₄ and the standby capsules are 48 EFPY projections and pertain to the most limiting core design case (lowest lead factor). The lowest lead factor is considered most limiting to prevent premature capsule withdrawal. Turkey Point Unit 3 and 4 operate under an integrated surveillance

Irradiation of Concrete - Design

Primary Shield Wall (PSW) Design configuration

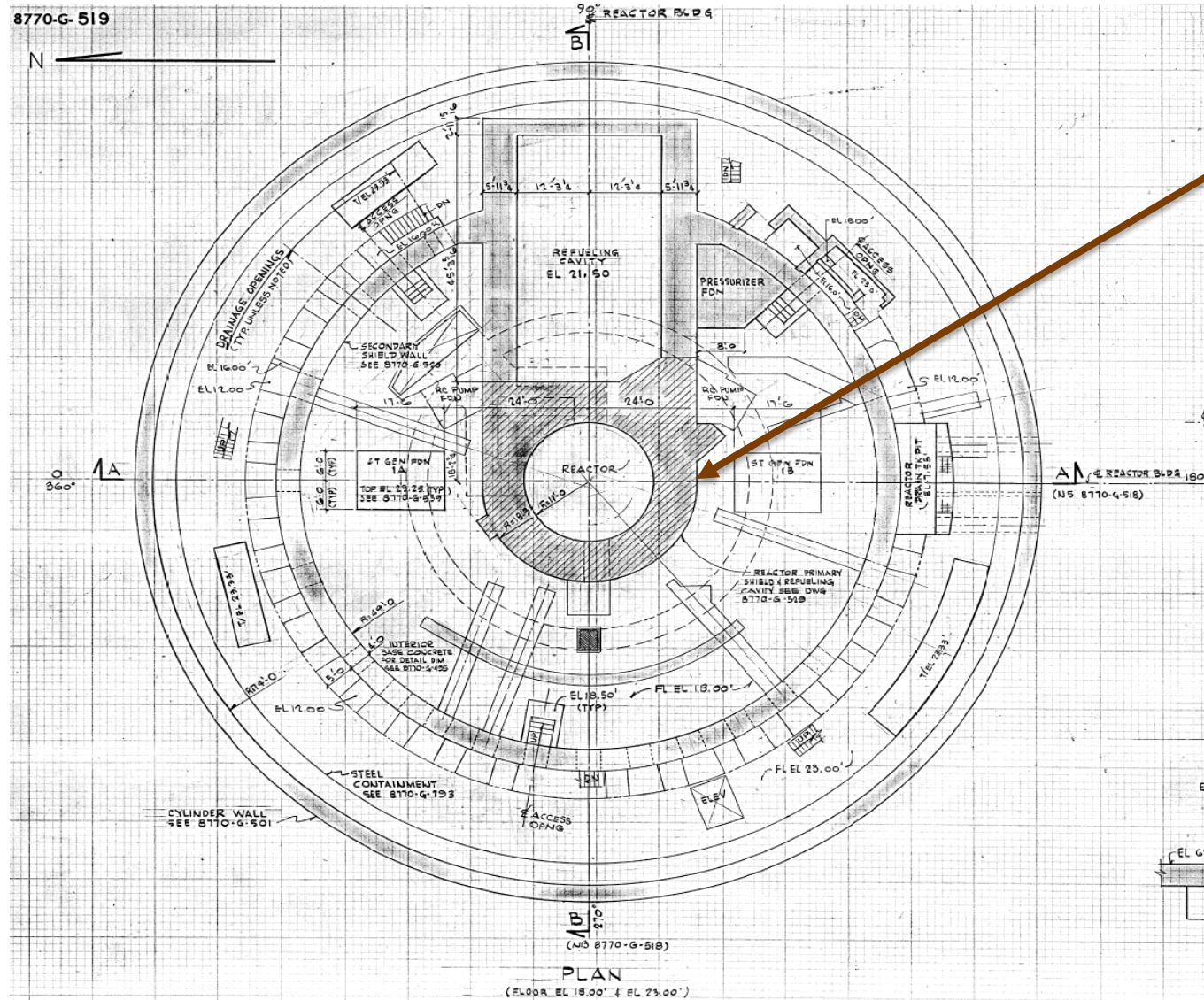
- The PSW is a 7 ft 3 in thick cylindrical reinforced concrete wall and surrounds the Reactor Pressure Vessel (RPV)
- Both Unit 1 and Unit 2 PSWs have the same dimensions and the same concrete properties
- Slight differences in reinforcement steel
 - Unit 2 PSW has slightly less vertical reinforcement
 - Unit 2 PSW has Grade 60 reinforcement steel vs Grade 40 for Unit 1
- 5000 psi concrete strength
- No liner plate

Irradiation of Concrete - Design



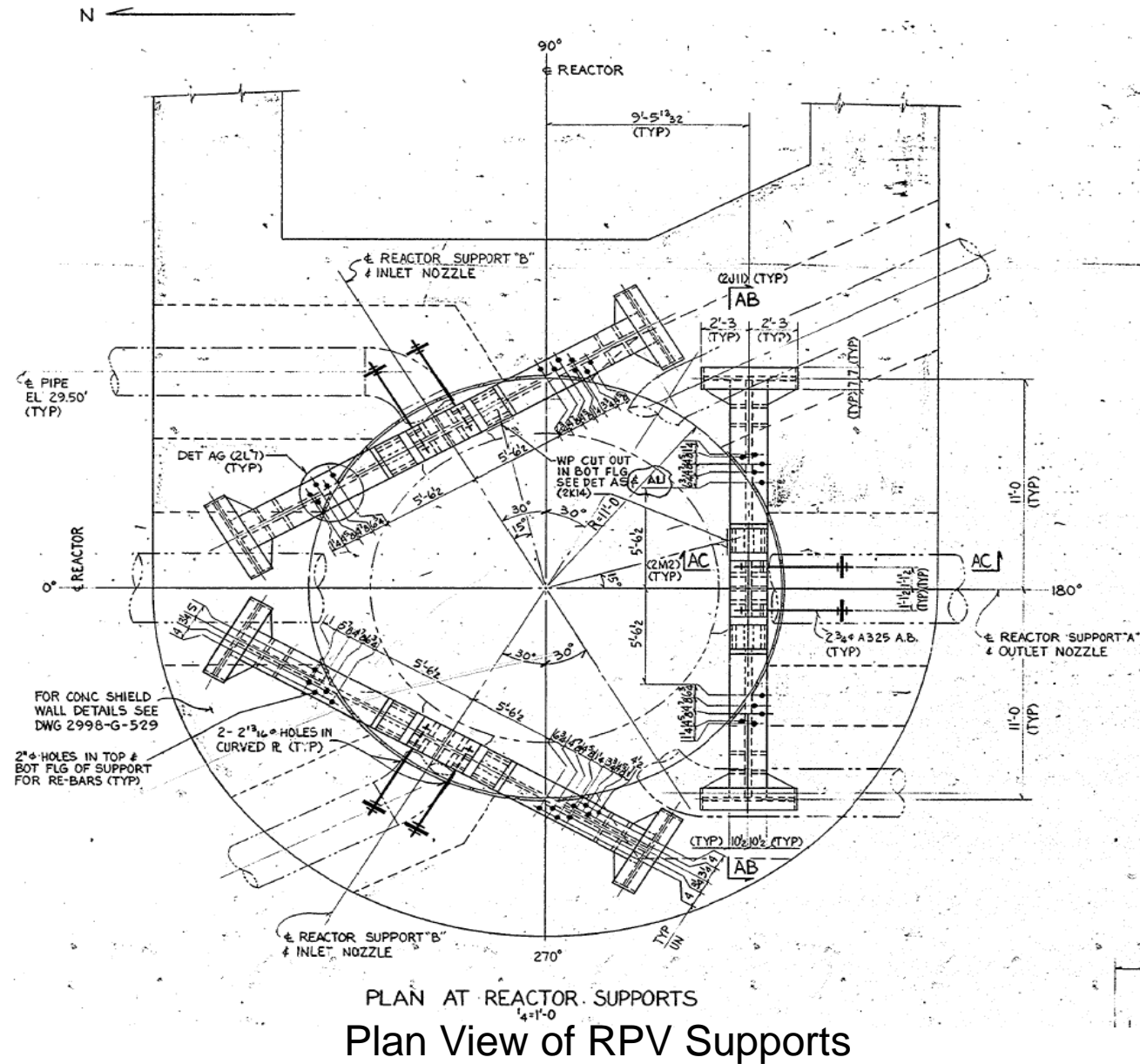
Elevation View of the Reactor Building

Irradiation of Concrete - Design



Plan View of the Reactor Building at Elevation 18 ft

Irradiation of Concrete - Design



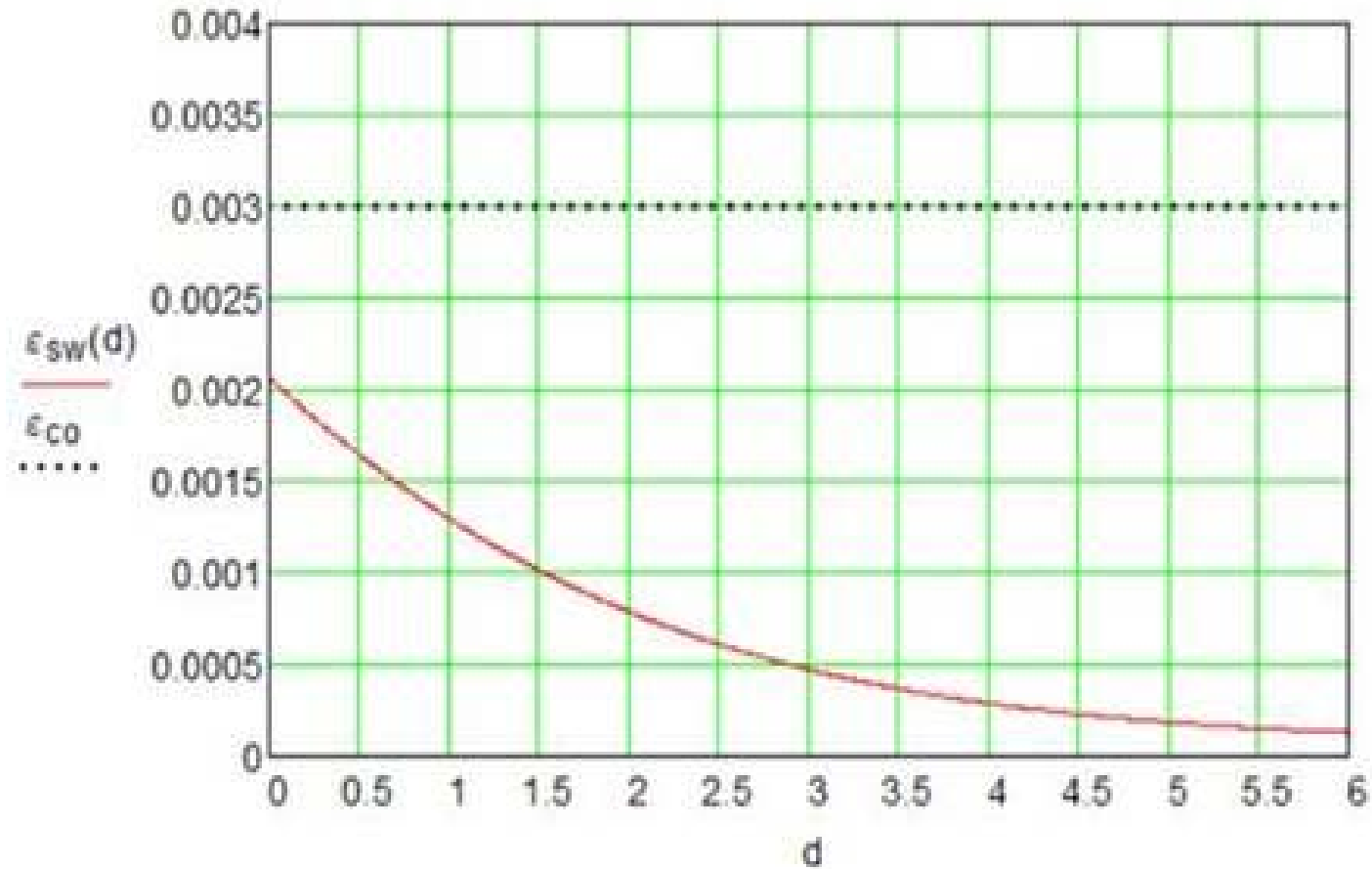
Irradiation of Concrete - Discussion

- Maximum exposures on the inner surface of PSW at the end of the SPEO (72 EFY) based on Westinghouse calculations (Unit 2 bounding)
 - Gamma dose – 6.62×10^9 rads (less than the NUREG-2192 threshold of 1.0×10^{10} rads)
 - Neutron fluence $E > 0.1$ MeV – 1.42×10^{19} n/cm² (greater than the NUREG-2192 threshold of 1.0×10^{19} n/cm²)
- PSW exposures result in minimal impact to the concrete
 - No impact due to gamma dose
 - Neutron fluence reaches threshold at ~0.8 inches into PSW
 - Neutron fluence effects including radiation-induced volumetric expansion (RIVE) will have minimal impact on interaction ratio (IR)

Irradiation of Concrete - Discussion

Concrete strain at ultimate strength per ACI 318-69 is 0.003

- Maximum strain due to RIVE is less than 0.003 thus RIVE depth is 0



Irradiation of Concrete - Discussion

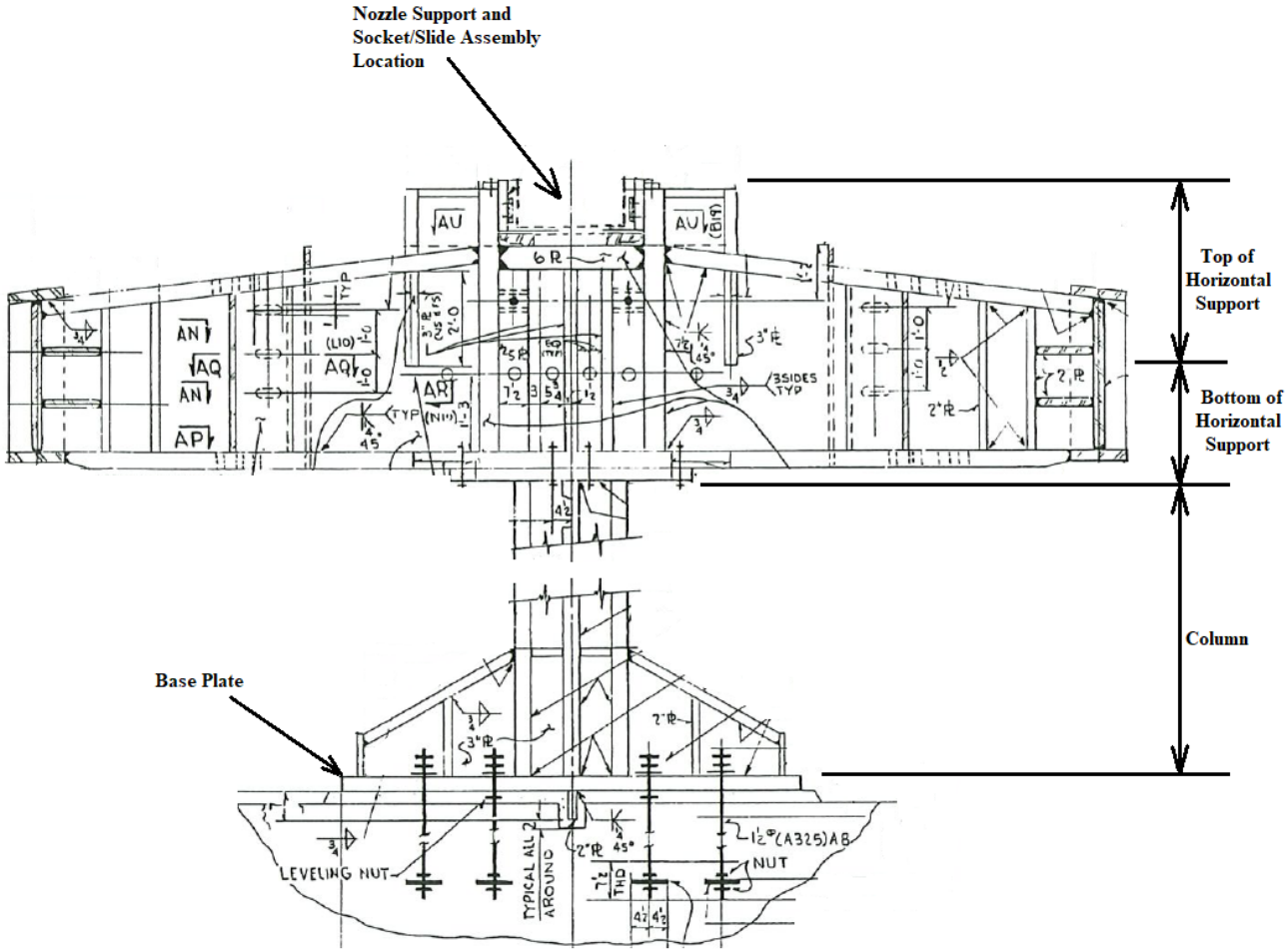
- IR in UFSAR (applicable to both units) = 0.77
 - Based on 42” guillotine break
 - Loads considering leak-before-break (LBB) of main loop piping consistent with CLB will result in a much lower IR
- Evaluation demonstrates PSW maintains its structural integrity under current licensing basis (CLB) loading when considering 80-year irradiation effects

Irradiation of RPV Supports - Design

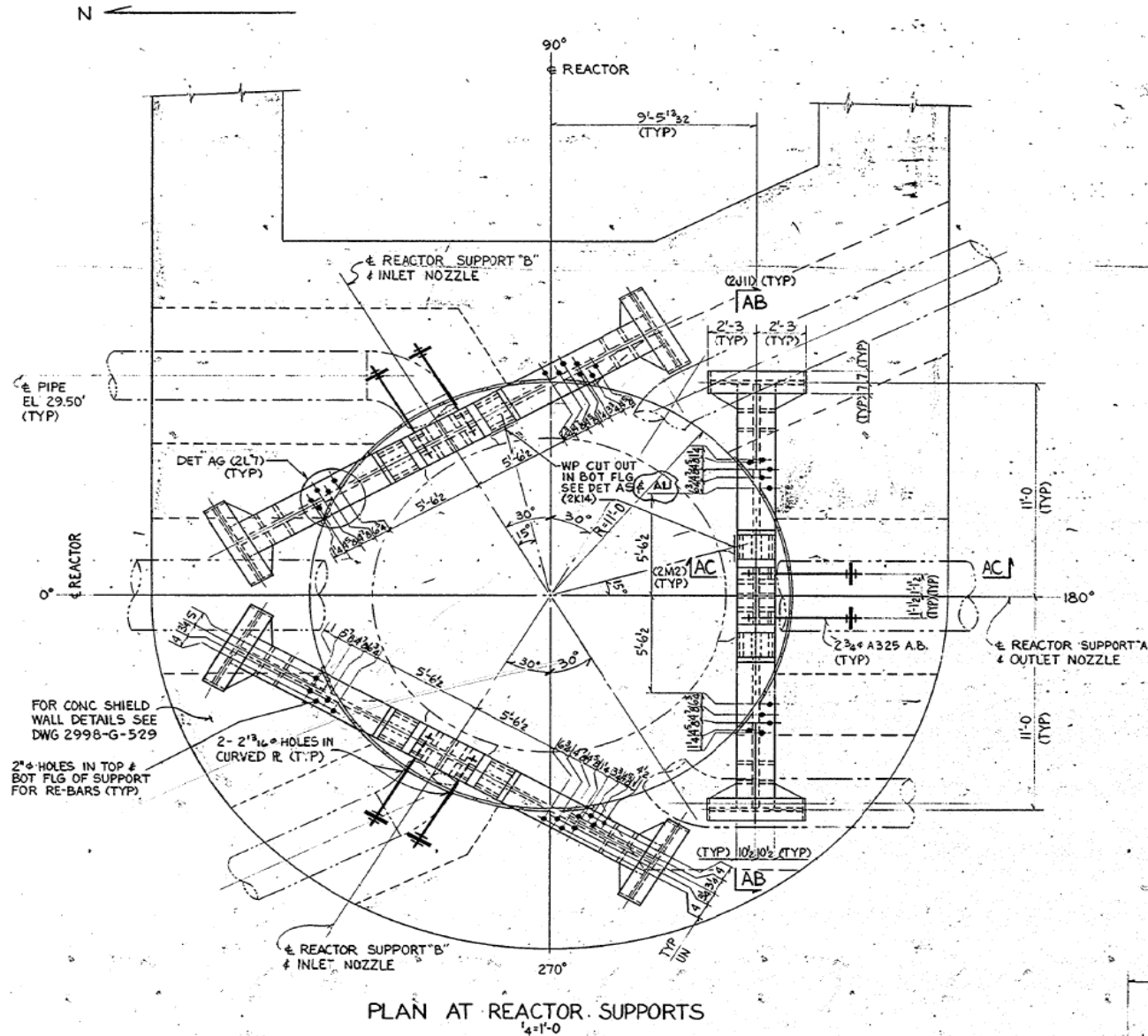
Design configuration

- RPV Supports
 - The RPV is supported at three points on three “T-shape” steel beam-column assemblies within the reactor cavity
 - The horizontal support beams are embedded in the PSW approximately 6 ft on each end
 - The column is bolted to the underside of the horizontal support beam at mid-span and to the reactor cavity floor
 - Load transfer between the RPV system and the RPV support occur between the nozzle pad which is welded to the reactor nozzle and steel bearing plates designed into the top of the steel horizontal support beam

Irradiation of RPV Supports - Design

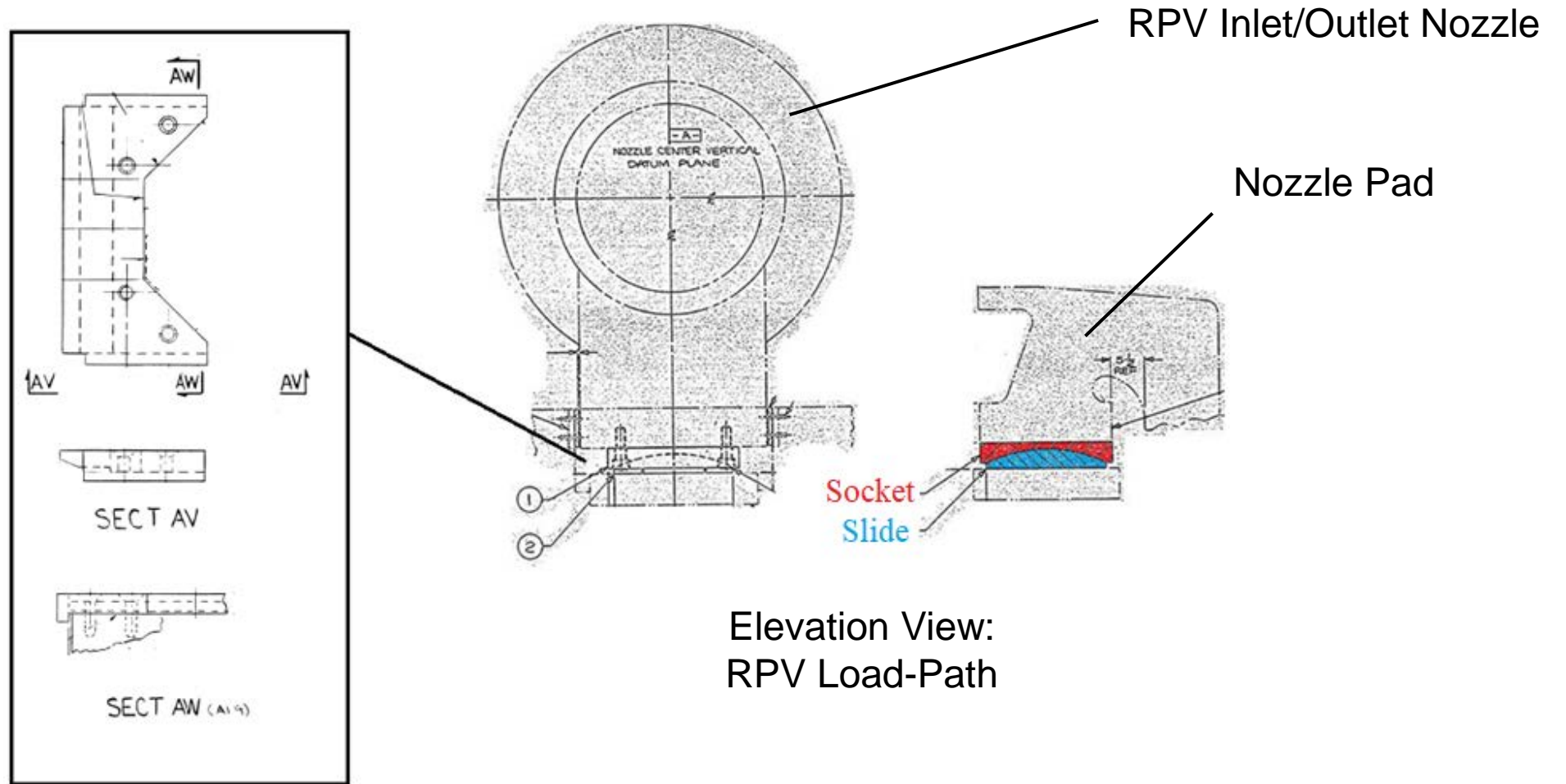


Irradiation of RPV Supports - Design



Plan View: RPV Supports

Irradiation of RPV Supports - Design



Irradiation of RPV Supports - Discussion

- FPL is performing a qualitative assessment of the PSL Units 1 & 2 RPV supports, as it pertains to the irradiation aging effects for the SPEO
- This assessment will provide the technical justification to support an inspection-based approach per NUREG/CR-1509
- The assessment has two (2) elements:
 - Qualitative comparison of the technical attributes
 - Compare PSL RPV Supports to Point Beach Nuclear (PBN)
 - Inspection-based attributes

Irradiation of RPV Supports - Discussion

Assessment topic areas include:

- Compare Geometry & Materials
 - Identify analogous components between PBN and PSL
 - Components reduce to plates and round bars
 - Compile all material types for downstream evaluation
- Calculate Fracture Toughness (K_{Ic}) using Conservative Fluence & Material Properties
 - Consider CMTRs and industry guidance as applicable
- Calculate Faulted Stresses (σ) from Plant-Specific Model using Conservative Loads
 - Loads are consistent with LBB auxiliary line breaks in the CLB
- Affirm Current Inspection Program
 - Review inspection capabilities
- Assessment
 - Compare ratios between PSL and PBN involving K_{Ic} and σ at critical locations
 - Favorable ratios (i.e., > 1) imply PSL postulated critical flaw sizes would be greater than those of PBN; therefore, PSL would have more margin than PBN, which FPL has evaluated as acceptable for an inspection-based approach
 - Ratios ranging from 2.5 – 19.6 have been calculated
 - Ample margins exist resulting in a favorable comparison supporting above premise
 - Utilize above comparison to affirm validity of current RPV Supports In-service Inspection Program

Irradiation of RPV Supports - Conclusion

FPL concludes the assessment will support that:

- A plant specific Aging Management Program (AMP) or an enhancement to an existing AMP will not be required (current inspections performed by ASME Section XI, Subsection IWF are sufficient)
- The RPV supports will continue to perform their intended functions consistent with the CLB when considering irradiation effects through the SPEO

Questions

Action Items