

An aerial photograph of the Diablo Canyon nuclear power plant. The plant's main containment dome is prominent in the center-right. To its left, a large body of water is enclosed by a breakwater, with waves crashing against the shore. The surrounding area includes green hills, parking lots filled with cars, and various industrial buildings. In the background, more rugged hills and a clear sky are visible.

Diablo Canyon
Independent
Safety Committee

Public Meeting
February 21 and 22, 2024

Avila Lighthouse Suites



Robert J. Budnitz, Member with R. Ferman Wardell, Consultant

- 1. Operations Staffing and Retention**
- 2. Unit 1 Reactor Vessel Embrittlement Update**
- 3. Maintenance Rule Update**
- 4. Probabilistic Risk Analysis (PRA) Update**
- 5. Meeting with NRC Resident Inspector**
- 6. Institute of Nuclear Power Operations (INPO) Update**
- 7. Meeting with DCCP Officer**
- 8. Independent Seismic Assessment Update**
- 9. Refueling Outage 1R24 Update and Outage Control Center**
- 10. Independent Assessment of Maintenance**
- 11. Accompany Operator on Unit 2 Rounds**
- 12. Observe Nuclear Safety Oversight Committee Meeting (11/30/23)**



Operator Staffing and Retention

- Two-tier Retention Plan for 2016–2020 and 2021–2023
- Two New Classes of Non-licensed Operators
 - January 2023 – 21 Candidates
 - August 2023 – 17 candidates
 - Another Class Is Being Planned
- License Upgrade Class Completed March 2023 and Another Scheduled to Complete Summer 2024
- Conclusion: DCPD Has Satisfactory Operator Staffing



Unit 1 Reactor Vessel Embrittlement Update

- DCISC Embrittlement Consultant's Nine Technical Questions of PG&E
- Answers Provided in This Meeting Are Incorporated into Dr. Kirk's Reports to Be Presented Tonight



Maintenance Rule (MR) Program Update

- **DCPP MR Program Complies with NRC 10CFR50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants”**
- **MR Applies to DCPP Structures, Systems and Components (SSCs) Based on Risk Significance**
- **Problem SSCs: Maintenance Preventable Functional Failures (MPFFs) and Put in (a)(1) Status for Correction & Monitoring**
- **The Number of SSCs in (a)(1) Status Has Been Declining – Good**
- **The Number of MPFFs Has Been Declining – Good**
- **Conclusion: DCPP MR Program Healthy and Effective**



Overall Probabilistic Risk Assessment (PRA) Program Review

- **DCPP PRA Calculates the Core Damage Frequency & Large Early Release (of Radioactivity) Frequency**
- **DCPP PRA Is the “Industry Gold Standard”**
- **Updated for Plant Procedural & Design Changes and for Updated Failure Database**
- **Last Full Update with Peer Review in April 2023**
- **PRA Also Supports the Following:**
 - **Plant Safety Decision-Making**
 - **License Renewal & Aging Management**
 - **Outage & Out-of-Service Equipment Management**
- **Conclusion: DCPP PRA Is Effective and Excellent**



Meeting with NRC Resident Inspector

- **Meet with NRC At All Fact-finding Meetings**
- **Items Discussed:**
 - **DCPP PMO++ Program**
 - **Outage 1R23**
 - **Recent NRC Inspections**
 - **DCPP License Renewal Application**
- **Conclusion: Meetings with NRC Are Beneficial**



Institute of Nuclear Power Operations (INPO) Update

Because of Confidentially Agreement with PG&E, the DCISC Cannot Share Details of INPO Activities & Evaluations

- **INPO Works for Nuclear Operating Excellence:**
 - **Biennial Plant Evaluations**
 - **Setting High Industry Standards**
 - **Providing Plant Operating Experience**
 - **Providing Plant Program Assistance**
- **DCPP Regularly Receives Positive Evaluation Results**
- **Areas of Concern Put into Corrective Action Program**



Meeting with DCPD Officer

- The DCISC met with Maureen Zawalick, Vice-President of Technical and Business Services
- Discussion Centered on This Fact-finding Agenda and Other Areas of Mutual Interest

Conclusions: The Regular Meetings Between the DCISC and DCPD Officers and Directors Continue to Be Beneficial for Both Organizations



Three Seismic Assessments

1. Ongoing PG&E–Sponsored Independent Seismic Evaluation Required by Senate Bill SB–846
2. Recent Independent Peer Review Panel Meetings
3. PG&E License Renewal Application Seismic–Safety Sections

Following Completion of These Activities, the DCISC will Revisit Its May 2023 Evaluation of Overall Seismic Risk and Report on Its Conclusions At the June 2024 Public Meeting

Conclusions: The Three Current DCCP Seismic Activities Are Progressing Appropriately



Outage 1R24 Update and Outage Control Center Observation

- **DCPP Unit 1 Was At 48% Full Power, Connected to the Grid & Holding for Required Testing**
- **DCPP Tests Included Chemistry Sampling & Analysis, Condenser Saltwater In-Leakage Measurements, and Reactor Engineering Power Increase Instructions**
- **All Outage Goals Were Met Except Collective Radiation Dose, Which Was Above the Goal Due to Aggressive Goal-Setting and Emergent Work**
- **The Outage Control Center Appeared Effective**
- **Conclusions: Outage 1R24 Was Performed Successfully Overall**



Independent Assessment of Maintenance

- SB–846 Mandated An Independent Assessment of DCCP’s “Deferred Maintenance”
- Assessment Performed By W.M. Dean Consulting Co.
- Assessment Performed April – October 2023
- Assessment Conclusion: *“DCCP Has Not Experienced Any Deferred Maintenance That Would Create A Vulnerability to Future Plant Operation or Warrant Any Remediation Actions.”*
- DCISC Conclusion: The Assessment Was Extensive and Intrusive, and Results Were Similar to the DCISC Assessment.



Accompany Unit 2 Operator On Rounds

- The Group Visited the Following Plant Turbine Building Areas:
 - Condenser Waterbox
 - Condensate Booster & Condensate Pumps
 - Feedwater Pumps
 - Moisture Separator Reheaters
 - Emergency Diesel Generator 2–1
 - Cable Spreading Room
 - Other Equipment in the Areas
- Conclusion: Plant Was Clean & Orderly with Equipment Operating Normally. DCPD Operator Was Knowledgeable About the Equipment



Observe Nuclear Safety Oversight Committee Meeting (Remote – November 30, 2023)

Because of Confidentially Agreement with PG&E, the DCISC Cannot Share Details of NSOC Activities & Evaluations

- NSOC Comprises Five Executive–Level External Industry Peers
- NSOC Provides An Independent Perspective on Plant Safety and Performance
- Four Days On Site
- Conclusions: The NSOC Appeared to Be Thorough and Comprehensive in Their Evaluations and Candid in Their Reports



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Per Peterson, Member, with Richard McWhorter, Consultant

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- 2. Outage Management Team Meeting**
- 3. Response to DCISC Recommendation on the Use of Earthquake Response Procedures**
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- 15. Meet with Nuclear Regulatory Commission (NRC) Senior Resident Inspector**



Refueling Outage 1R24 Results

- Outage Began October 1, 2023, and Ended November 13, 2023.
- All Major Work Activities Completed as Planned, Including License Renewal Inspections.
- All Goals Met Except Radiation Dose (38.4 vs. 35 Person-Rem) and Reliability (26 vs. 90 Days).
- Leaking Pressurizer Safety Valve Required Subsequent Shutdown for Repair (Maintenance Outage 1X25).
- Additional Briefing from PG&E Scheduled for Tomorrow's Session.
- Conclusion: DCCP's Refueling Outage 1R24 was successfully performed. The DCISC should follow up on reviewing the causes and corrective actions for Maintenance Outage 1X25.



Outage Management Team Meeting

- Senior Leadership Review of:
 - Projects or Work in Jeopardy of Being Not Fully Prepared for Outage
 - Planning and Scheduling Issues
 - Scope Additions and Risk Decisions
 - Recovery Plans for Problem Areas
 - Change Management and Contingency Planning
- Main Meeting Topics:
 - Reviewed 2R24 Turbine Work Scope
 - Reviewed 2R24 Reactor Cavity Seal Modification
- Conclusion: The December 12, 2023, Outage Management Team meeting was conducted efficiently and effectively.



Response to DCISC Recommendation on the Use of Earthquake Response Procedures

- Recommendation from July Fact-Finding Report
- Ensure Procedures Include Transition Points for Assessing Availability of FLEX Equipment and Using as Needed in Post-Earthquake Situations
- Changes Completed to Primary Earthquake Response Procedure, CP M-4
- Changes to Additional Procedures Under Review
- **Conclusion:** DCPD initiated appropriate follow-up actions in response to a DCISC recommendation concerning post-earthquake procedures. The DCISC should review the status of the follow-up actions again during a future Fact-Finding Meeting in mid-2024.



Training Programs for New Engineers

- Initial Training
 - Engineering Support Personnel Initial Training Program (INPO Accredited Program)
 - Individual Qualification Programs
 - Individual Development Plans
- Recurring Training
 - Individual Development Plans
 - Knowledge Transfer Plans (Facilitated by Retired Plant Staff Member)
- Conclusion: DCCP's training programs for new engineers were well organized and appropriately focused to maintain an adequate level of technical knowledge within the Engineering Department.



Intake Cove Maintenance and Dredging Project Update

- Review Prompted by Email from A4NR Alleging Improper Deferral of Dredging Project and Improper Use of Divers Cleaning Intake Areas.
- Dredging Project Deferred for One Cycle Due to Complexity.
- Divers Routinely Clean Areas Around Intake but Were Not Being Used As a Substitute for Dredging Project; Scope of Divers' Work Was Appropriate.
- No Nuclear Safety Concerns; Referred to DCCP Employee Concerns Program for Further Review; Follow-up in January Fact-Finding Meeting.
- **Conclusion:** The dredging project was being properly managed for completion in the spring of 2024, and maintenance activities using divers in the Intake Cove were appropriate and not precluded by the station's environmental permits.



Unit 1 Reactor Vessel Embrittlement Update Including Efforts to Remove Capsule B

- Discussed Embrittlement Consultant's Three Technical Questions of PG&E. Answers Provided in This Meeting Are Incorporated into Consultant's Reports to Be Presented at Evening Public Meeting Session.
- Reviewed History of Unit 1 Vessel Inservice Inspection Program Results (Weld Inspections).
- Reviewed PG&E's Efforts Made in 1R24 to Retrieve Capsule B. Efforts Unsuccessful Due to Inability to Get Tool to Engage with Sample Tube Plug (Also to be Discussed at Evening Public Meeting Session).
- Conclusion: PG&E provided information on past Unit 1 Reactor Vessel weld inspection results along with answers to questions related to vessel embrittlement.



Refueling Outage 1R24 License Renewal Inspection Results

- License Renewal Inspections Completed (~184 Total):
 - Small-bore Piping Welds
 - Refueling Water, Diesel Fuel Oil, and Condensate Storage Tank
 - Concrete Inspections
 - Electrical Testing and Cable Inspections
- Results:
 - No Aging-Related Challenges to Any System's Ability to Perform Function.
 - Four Minor Inspection Findings Requiring Additional Evaluation.
- Conclusion: The DCISC considered these results to be excellent performance and provided a strong assurance of continued safety during a period of extended operations.



License Renewal Application Overview

- License Renewal Application Contains These Major Sections:
 - Scoping Methodology (Section 2)
 - Scoping Results (Section 3)
 - Time-Limited Aging Analyses (Section 4)
 - Aging Management Program Descriptions (Appendix B)
 - Environmental Report (Appendix E, 1100+ Pages)
- Results
 - 44 Aging Management Plans to be Implemented at DCCP.
- Conclusion: DCCP submitted its new License Renewal Application on November 7, 2023, and the application was deemed sufficient and accepted by the NRC on December 14, 2023.



Update on the Use of Electronic Procedures

- Current Focus on Refueling Outages and License Renewal-Related Work.
- No Current Effort to Implement Electronic Procedures.
- Desire to be Proactive in Innovation in the Future, and the Electronic Procedure Effort Could be Restarted.
- Conclusion: DCPD is not currently pursuing the use of electronic procedures at the station but is looking to be innovative in the use of new technologies in the future. The DCISC should review this topic again in late 2024.



Management Observation Programs

- Focused on Requiring Supervisors to Routinely Observe Employees in the Field and Discuss Their Observations in a Collaborative Fashion.
- Data From Observations Made Within Departments Rolled Up Into Station-Wide Tracking Program.
- 1,246 Observations Made Mid-September to Mid-December (Including 1R24).
- Strengths and Opportunities Categorized and Tracked; Also Reviewed at Departmental Observation Review Meetings.
- Conclusion: A large number of observations were being completed, and the observations provided valuable insights into human performance strengths and opportunities at the station.



Emergency Preparedness Department

- The Department Manages Training for the Groups of Employees that Provide Staff for Emergency Response Facilities During an Emergency Event.
- Four Teams of About 70 Individuals Per Team
- Past Issues with Attendance at Training and Drills Resolved.
- Dynamic Learning Activities Being Used to Improve Team Member Proficiency.
- Discussed Other Department Activities and the Next NRC Evaluated Exercise Scheduled for July 31, 2024.
- Conclusion: DCPP's Emergency Preparedness Department was performing well overall, and the DCISC should plan to observe the next evaluated emergency preparedness exercise on July 31, 2024.



Meet with DCPD Officer

- **Maureen Zawalick, Vice President, Business and Technical Services**
- **Discussed the Fact-finding Agenda Items and Other Items of Mutual Interest**
- **Conclusion: The regular meetings between DCISC and DCPD Officers and Directors continue to be beneficial for both organizations.**



Auxiliary Saltwater Pump 2-2 Degradation and Exigent Technical Specification Change

- August and October Motor Bearing Oil Testing Found Minor Iron Contamination Indicative of Abnormal Bearing Wear (Pump Remained Operable).
- Decided to Promptly Replace Motor Rather than Wait for Spring Outage.
- Typical Motor Replacements Require Nearly All of 72 Hours Allowed; Better to Request More Time (144 Hours) from NRC.
- Cause Evaluation Will Be Performed After Motor Removal.
- Conclusion: There were no significant safety concerns with the discovery of minor degradation of the oil in the lower motor bearing for Auxiliary Saltwater Pump 2-2, and DCCP's plans to replace the motor were prudent.



Low Temperature Overpressurization Protection System (LTOPS)

- Designed to Control Reactor Coolant System (RCS) Pressure at Low Temperatures Such that the Integrity of the RCS Pressure Boundary is Not Compromised.
- Controls Setpoints for Two Safety-Related Pressurizer Power Operated Relief Valves and is Enabled at Low RCS Temperatures.
- Setpoints, Temperature Limits, and Allowed Equipment Configurations Established by the Pressure and Temperature Limits Report (PTLR).
- PTLR Calculations Assume a Preexisting Crack in the Reactor Vessel.
- Conclusion: DCCP appropriately uses a Low Temperature Overpressure Protection System to protect against an inadvertent overpressurization of the Reactor Vessel at low temperatures.



Meet with NRC Resident Inspector and Regional Inspector

- **Items Discussed Included:**
 - **Recent NRC Inspection Activities**
 - **Refueling Outage 1R24 Results and Refueling Outage 2R24 Preparations**
 - **DCPP' s Corrective Action Program**
- **Conclusion: DCISC' s meetings with the NRC continue to be beneficial.**



Per Peterson, Member, with Richard McWhorter, Consultant

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Peter Lam, Member with R. Ferman Wardell, Consultant

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- 12. Emergency Diesel Generator Update**



Observe Plant Health Committee Meeting

- **Meeting Cancelled Due to Conflict with Emergency Drill**



2R24 Refueling Outage Plans

- **Spring 2024: 50–Day Outage**
- **Similar to 1R24 Refueling Outage**
- **Primary System Maintenance, Testing, and Repairs**
- **Secondary System Maintenance, Testing, and Repairs**
- **Electrical Systems Maintenance, Testing, and Repairs**
- **License Renewal Inspections**
- **Projects (next page)**



2R24 Refueling Outage Plans, Continued

- **Projects:**
 - **500 kV Tie-Line Relay Upgrade**
 - **Condensate Booster Pump 2–2 Pedestal Repair**
 - **Condenser Steam Side Lagging Repairs**
 - **Circulating Water Pump Neutral Connection Relocation**
 - **Main Condenser Saltwater Expansion Joint Replacements**
 - **Main Condenser Waterbox and Tubesheet Coatings Refurbishment**
 - **Pipe Gallery Vital Area**
 - **Replace Paper/Chart Recorders with Digital Recorders**
 - **Rod Control Power Supply Replacement to Lower Spurious Trip Risk**
 - **Transformer Repairs, Refurbish and Refill of Oil**
 - **Traveling Screen Frame Replacements**

Continued



2R24 Refueling Outage Plans, Continued

- Outage Goals:
 - Zero Recordable Injuries
 - Zero Nuclear Safety Events – No Loss of Decay Heat Removal
 - Zero Serious Injuries or Fatalities (SIF) & Zero SIF Potentials
 - Zero Human Error Site Clock Resets
 - Zero Foreign Material Exclusion Events
 - Outage Duration: $\leq$ 50 Days
 - Radiation Dose Goal: $\leq$ TBD (As Low As Reasonably Achievable)
 - Reliability: Power Ascension: $\leq$ 5 Days
 $\geq$ 90 Days Maximum Capable Power

Continued



2R24 Refueling Outage Plans, Continued

- Conclusions:
 - 2R24 Outage Plans Appeared Appropriate
 - Similar Unit 1 Outage Was Successfully Completed



Meeting with NRC Senior Resident Inspector

- **DCISC Meets with NRC At All Fact-finding Meetings**
- **Items Discussed:**
 - **Recent and Future Inspection Activities**
 - **Refueling Outages 1R24 Results and 2R24 Plans**
 - **Replacement Plans for NRC Resident Inspector**
 - **Three Non-Cited Violations in Upcoming Inspection Report**
 - **One Allegation on Emergency Diesel Fuel Leak – NRC Found No Issues**
- **Conclusion: Meetings with NRC Are Beneficial**



2023 Operating Plan Results and 2024 Operating Plan

(PG&E Presentation Later in Public Meeting)

Results for the 2023 Operating Plan were as follows:

<u>Goal Item</u>	<u>Goal</u>	<u>Actual</u>	 = Continuous Improvement
Achieve Continued Operations Milestones			
Attain LEAN Maturity			
Experience Joy at Work			
Reliability & Safety Indicator	≥ 97.5	100.0	
OSHA Recordables	0	1	
Days Away, Restricted or Transferred	0	0	
Preventable Motor Vehicle Incidents	0	0	Continued



2023 Operating Plan Results and 2024 Operating Plan, Continued

2024 Goals (PG&E Presentation Later in Public Meeting)

<u>Goal Item</u>	<u>Goal</u>
Achieve Continued Operations Milestones	↗
Attain LEAN Maturity	↗
Experience Joy at Work	↗
Reliability & Safety Indicator	≥ 97.5
OSHA Recordables	0
Days Away, Restricted or Transferred	0
Preventable Motor Vehicle Incidents	0



Unit 1 Reactor Vessel Embrittlement

- **Purpose: Receive and Understand PG&E Review Comments on Possible Factual Errors or Omissions in Mark Kirk Reports**
- **Dr. Kirk to Make Editorial Corrections to Reports**
- **Conclusions:**
 - **Comments Were Editorial Corrections, Which Did Not Have a Significant Effect on the Reports**



2024 Spent Fuel Loading Campaigns

- Campaign = Moving Spent Fuel from Spent Fuel Pool to ISFSI
- Last Loading Campaign Was in 2018
- In 2024 PG&E Plans Six Campaigns Per Unit = 384 Fuel Assemblies
- Campaigns Will Run from July through October 2024
- Improvements in Campaign Process and Training
- All Spent Fuel Will Go Into Holtec Casks/Overpacks
- New Orano System Planned To Be Available in 2030, Pending Seismic Qualification
- Conclusions: DCCP Plans for 2024 Spent Fuel Campaigns Appear Appropriate



2023 Regulatory Year in Review

- **DCISC Receives Regulatory Updates at Each Public Meeting**
- **Significant NRC Regulatory Activities in 2023:**
 - **NRC Spent 5600 Inspection Hours At DCPD in 2023**
 - **11 Non-Cited Violations, Lowest in NRC Region IV**
 - **All 16 NRC Performance Indications Were Green**
 - **DCPD Submitted License Amendment Request on Risk-Informed Completion Times with NRC Approval Expected May 2024**
 - **DCPD Submitted License Amendment Request for License Renewal in November 2023 – NRC Has Accepted As Content**



Post-Refueling Outage 1R24 Reactor Physics Tests

- **Technical Specifications Require Core Physics Testing After Each Refueling Outage:**
 - Control Rod Worth
 - Subcritical Negative Reactivity
 - Moderator Temperature Coefficient
- **DCPP Used New Physics Test in 1R24: “Alternate Rod Worth Test”**
 - Lower Test Risk
 - Saved Six-to-Eight Hours of Outage Startup Time
- **Conclusion: Improved Reactor Physics Tests Lowered Risk and Saved Outage Time**



Intake Cove Dredging Update

- DCISC Received Anonymous Allegation from A4NR on Dredging
- Alleged Retaliation, Illegal Operation, Permit Violation, Etc.
- DCISC Investigated in December Fact-finding Meeting But Found No Improprieties or Problems
- DCISC Requested Employee Concerns Program (ECP) Investigate with DCISC Follow Up at January Fact-finding Meeting
- Conclusions: DCPPECP Found No Evidence of Dredging Issues, and DCISC Found No Improprieties.



Observe Reactor Operator Continuing Training on Simulator

- Training on “Faulted Steam Generator”
 - Classroom Training Was Complete and Class Moved to Simulator
 - DCISC FFT Observed from Simulator Operating Booth
 - Operations Crew Used Proper Human Performance Attributes
-
- Conclusions: Training Was Successfully Completed and Trainers and Operations Crew Performed Satisfactorily



Air– and Motor–Operated Valve Programs

- **Purpose: Test and Maintain AOVs and MOVs to Assure They Will Function Properly Under Anticipated System Conditions**
- **Four Categories of Valves:**
 - 1 Safety–Related High Significance
 - 2 Safety–Related Low Significance
 - 3 Not 1 or 2 – Generation Significant
 - 4 Any Remaining Valves
- **Tested Regularly, Especially During Refueling Outages**
- **Conclusions: Programs in Green (Good) Health and Well Implemented**



Emergency Diesel Generator (EDG) Update

- EDGs Provide Emergency Power with Loss of Offsite Power
- Three EDGs Per Unit with Crosstie Capability
- FFT Toured EDG 1–2 in Turbine Building with System Engineer
- EDGs Health Is Green in Both Units
- System Engineer Knowledgeable on System
- Plant Condition Clean and Orderly
- Conclusions: All EDGs in Green Health and Reliable



Peter Lam, Member with R. Ferman Wardell, Consultant

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An Evaluation of the Status of Diablo Canyon Unit 1 with Respect to Reactor Pressure Vessel Condition Monitoring and Prediction

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PEAI

DCISC Public Meeting

Alvia Beach, California

21 February 2024



**Phoenix
Engineering
Associates
Inc.**



BACKGROUND

Administrative. Embrittlement measurement & prediction. RPV integrity management.



NRC REQUIREMENTS & GUIDANCE

For monitoring & embrittlement prediction. For structural integrity



EVALUATION OF DIABLO CANYON UNIT 1

Surveillance program. NRC's required analysis. Supplemental analysis.



ANSWERS TO PUBLIC'S CONCERNS



Administrative Documentation

- **Objectives**

- Address concerns raised by SLOMFP, FOE, & Mr. B. Severance
- Independent evaluation of Unit 1 RPV condition

- **Two reports**

- Part 1 addresses public's concerns
- Part 2 evaluates the embrittlement of the Diablo Canyon Unit 1 reactor pressure vessel (RPV)

- **Reports reviewed by**

- DCISC consultants
- DCISC members individually
- PG&E to check for omissions & errors of fact only

Reviews did not affect report conclusions

An Evaluation of the Status of Diablo Canyon Unit 1 With Respect to Reactor Pressure Vessel Condition Monitoring and Prediction

Part 1: Addressing Public Concerns

Consultant's report to the Diablo Canyon Independent Safety Committee

Submitted by

Mark Kirk

Phoenix Engineering Associates Inc.

Unity, New Hampshire, USA

Date: 26 January 2024



Phoenix

Engineering

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Inc.

<https://www.dcisc.org/>

An Evaluation of the Status of Diablo Canyon Unit 1 With Respect
to Reactor Pressure Vessel Condition Monitoring and Prediction

[Letter Transmitting Two Reports by Dr. Mark Kirk to the DCISC. \(PDF\)](#)

[Report Part 1: "Addressing Public Concerns." \(PDF\)](#)

[Report Part 2: "Evaluation of Diablo Canyon Unit 1 Embrittlement."](#)

(PDF)

Administrative

Where are public's concerns addressed?

Concerns

Continued Operating Safety of Unit 1

- Data credibility
- Surveillance capsule withdrawal plan
- Use of similar (“sister plant”) data
- RPV beltline inspections
- Alternate testing methods (nano indentation)
- Alternative Charpy analysis method
- Aspects of the RPV analysis methodology
- Deficient materials



BACKGROUND



NRC REQUIREMENTS AND GUIDANCE



EVALUATION OF UNIT 1



ANSWERS TO PUBLIC'S CONCERNS

1. Background

Part 1 Report
Section 2.1, 2.2, and 2.3

Key terms

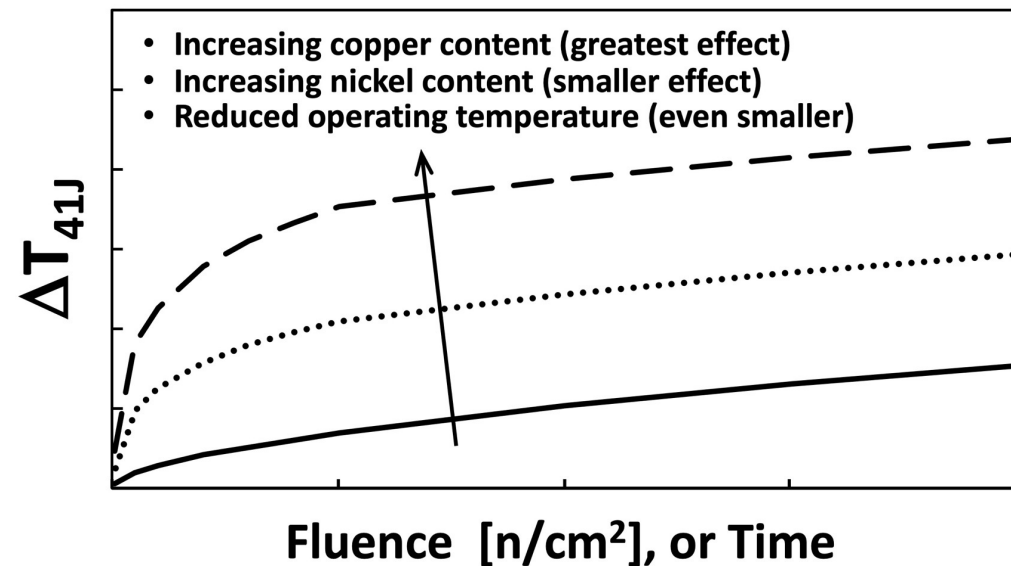
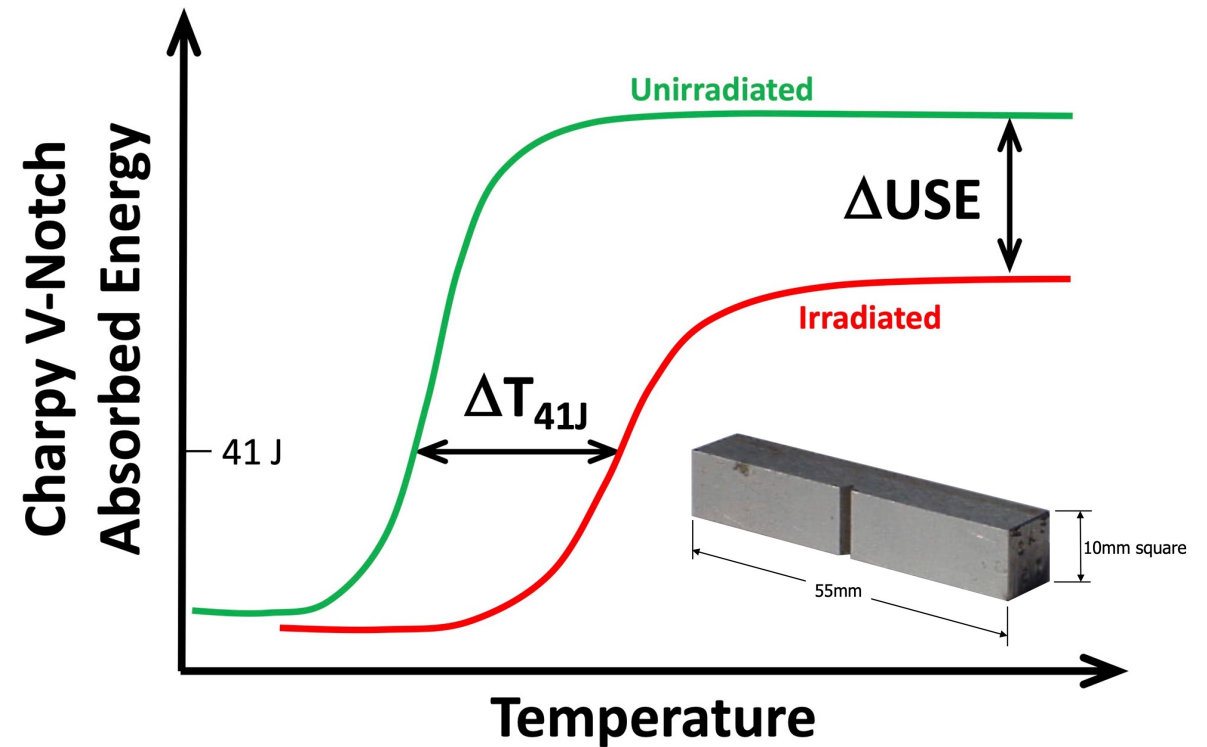
- Embrittlement
- Fracture toughness
- Surveillance program

Embrittlement forecasting

Assessment of RPV Integrity (Screening Criteria)

Embrittlement

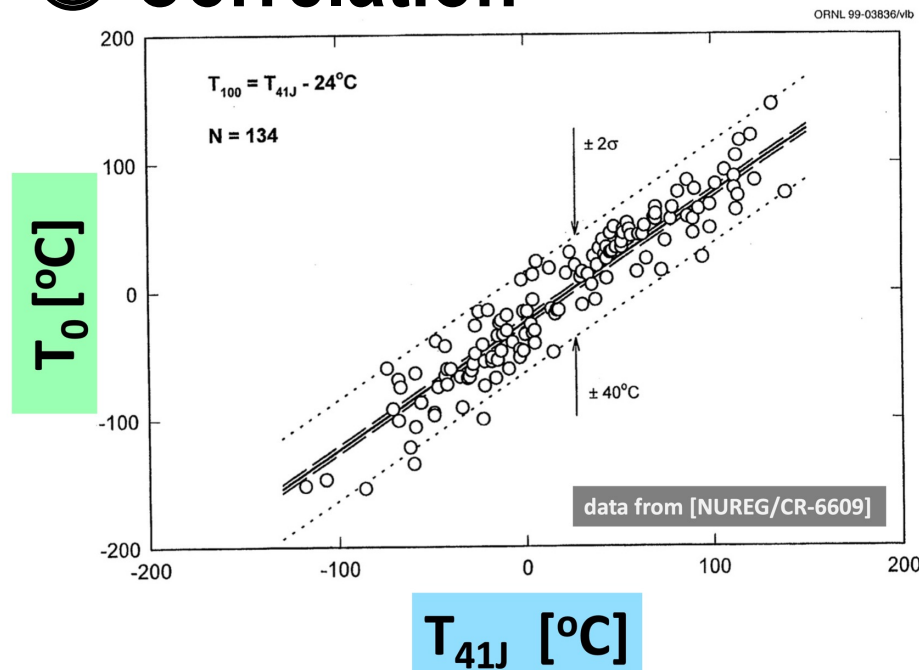
- Embrittlement reduces the steel's resistance to failure
 - Embrittlement changes RPV steel at a microstructural level
 - Embrittlement does not cause cracking
 - Embrittlement does reduce energy absorbed by the steel before fracture
 - Increase in Charpy transition temperature (T_{41J})
 - Reduction in Charpy upper shelf energy (USE)
- Embrittlement occurs progressively over the plant's operating life
 - Faster early in life
 - Slower as plants age
 - Steel composition affects embrittlement rate



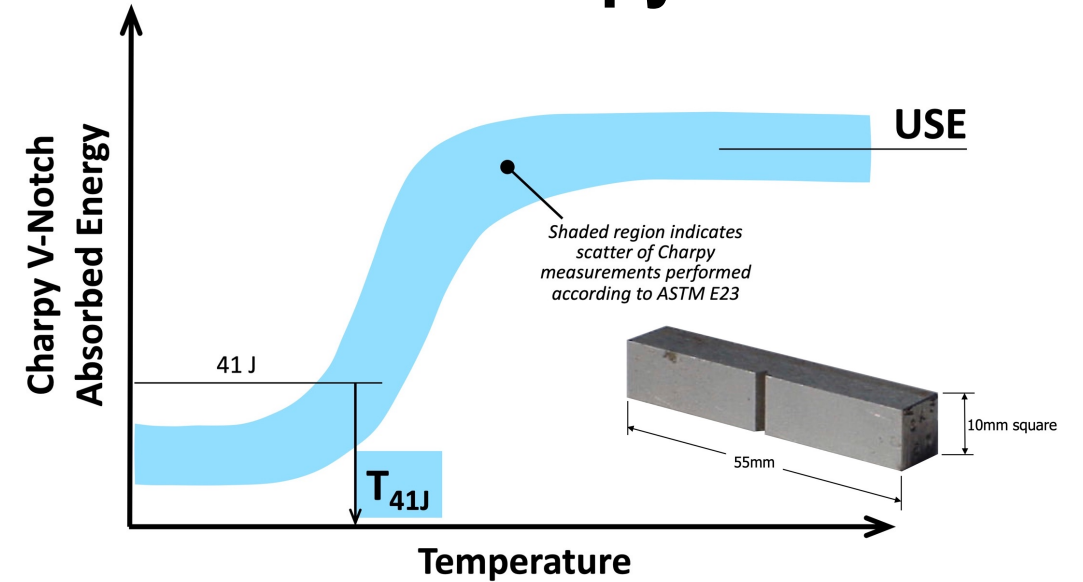
Fracture Toughness

- Fracture toughness needed to assess plant structural integrity (ASME, NRC)
- Charpy specimens have a machined notch, while fracture toughness is measured using a specimen with a sharp fatigue crack
- Charpy T_{41J} data correlates well with fracture toughness

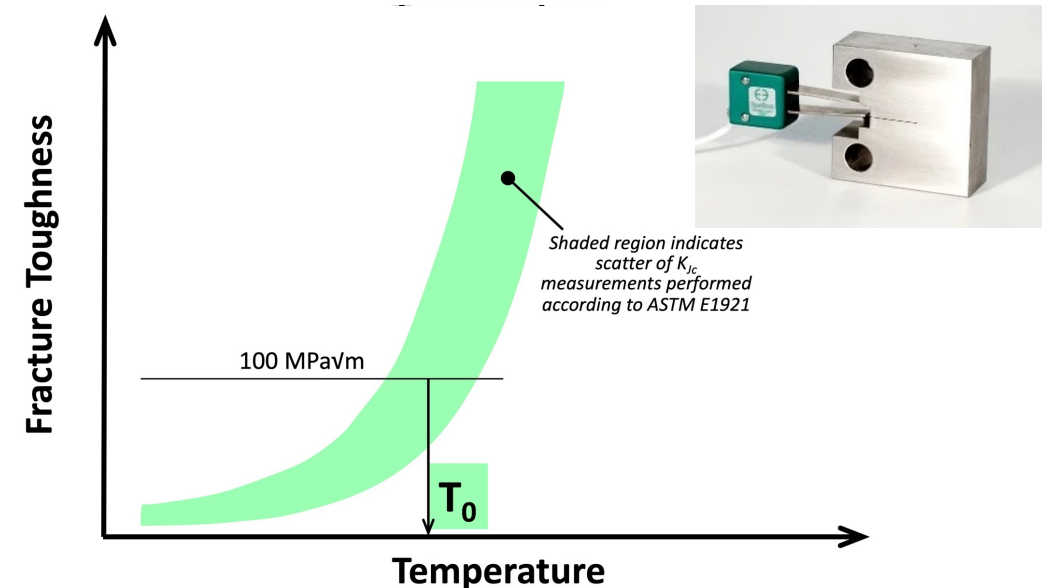
③ Correlation



① Measure Charpy



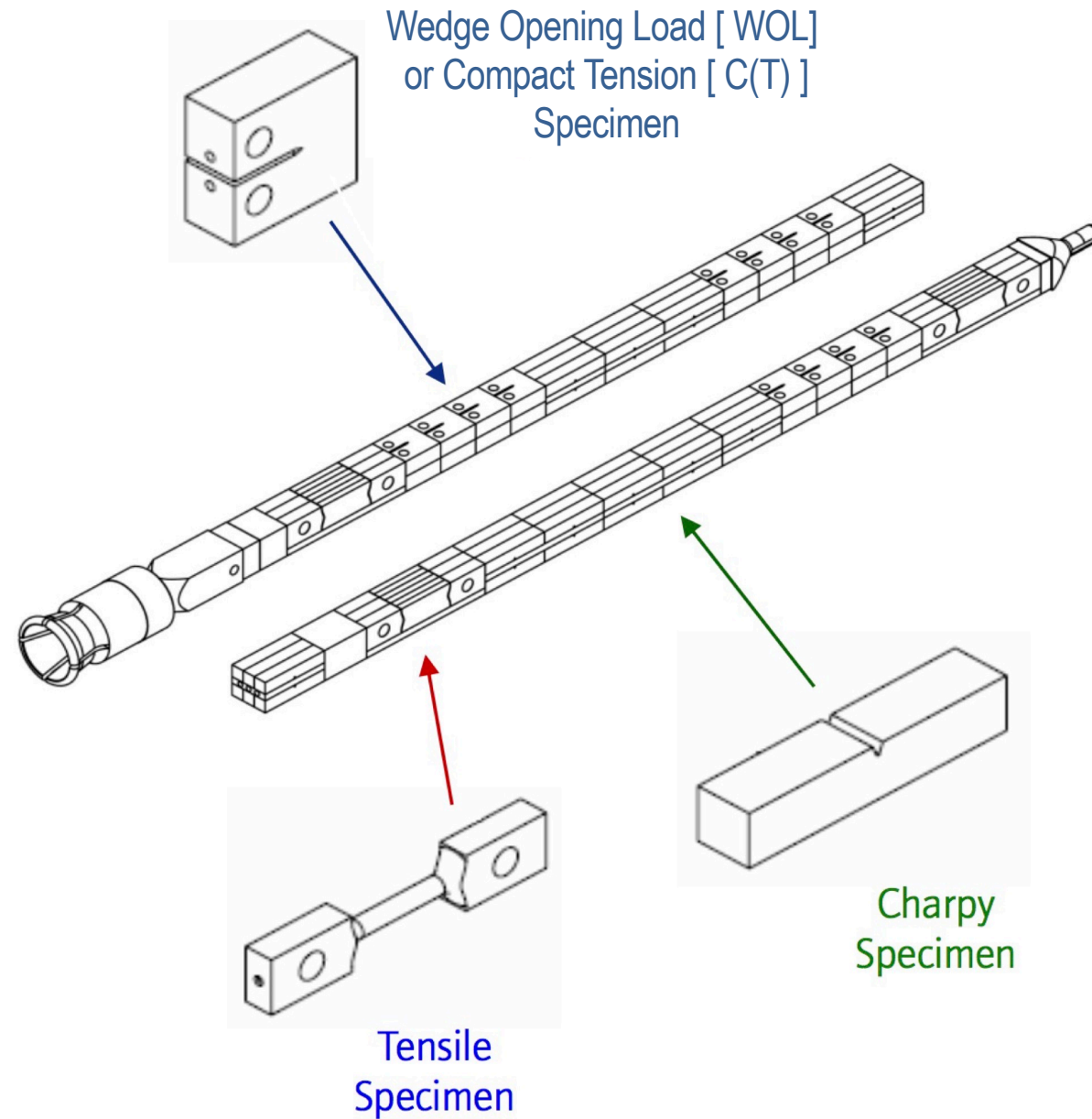
② Want fracture toughness



Surveillance Program

1

Surveillance capsules are loaded with specimens.

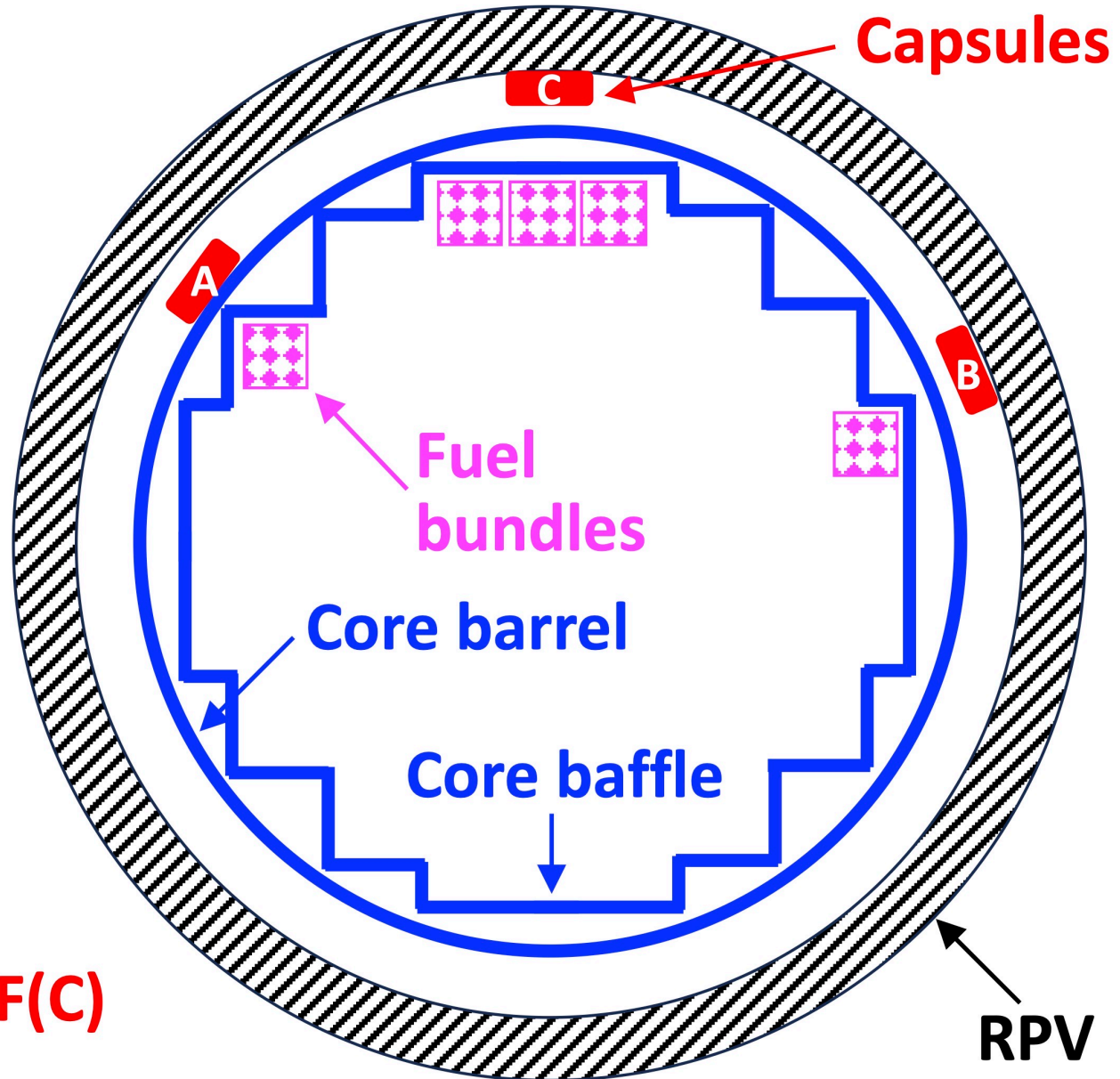


Surveillance Program

2

Surveillance capsules are placed inside the RPV. Capsule distance from fuel determines capsule lead factor (LF).

$$LF(A) > LF(B) > LF(C)$$

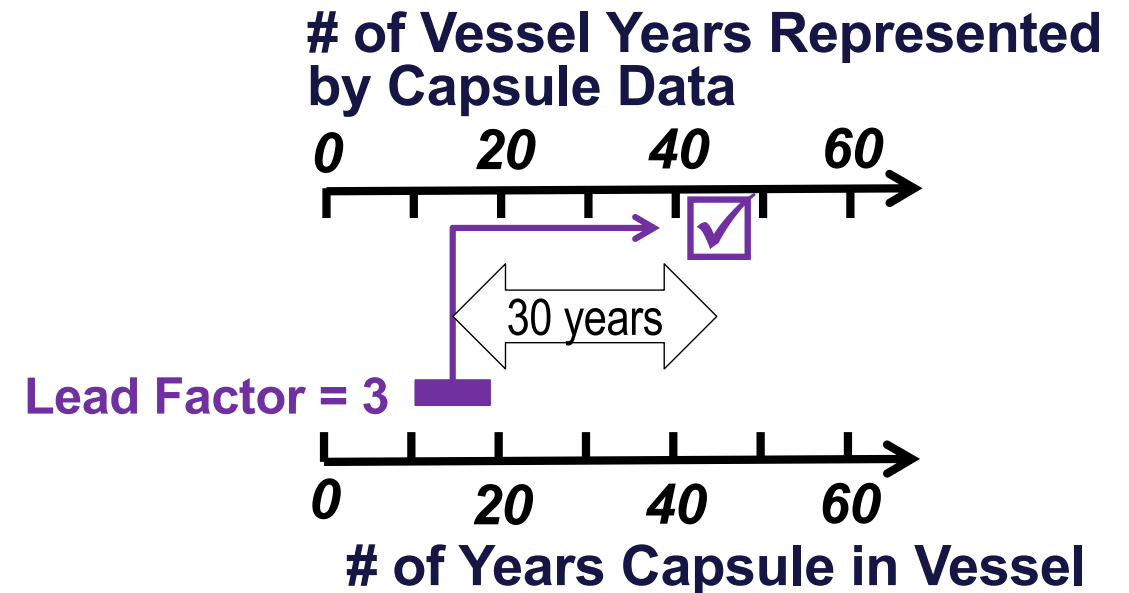


Surveillance Program

3

Higher lead factors provide greater advance information on RPV embrittlement.

- Specimens in capsules experience more embrittlement than the RPV
- Specimens represent the RPV condition years into the future
- Long intervals between capsule withdrawals are acceptable

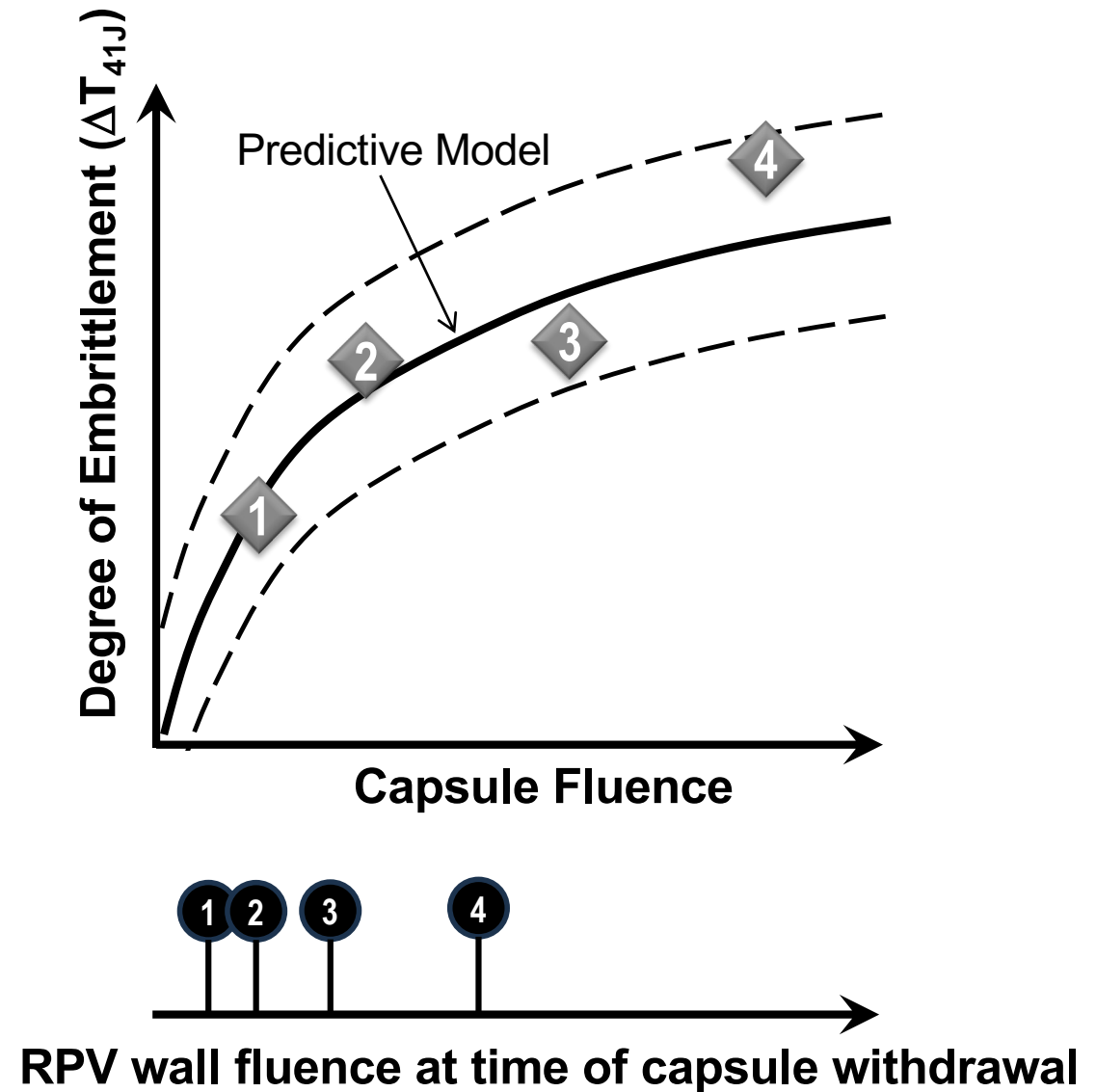


Surveillance Program & Embrittlement Forecasting

4

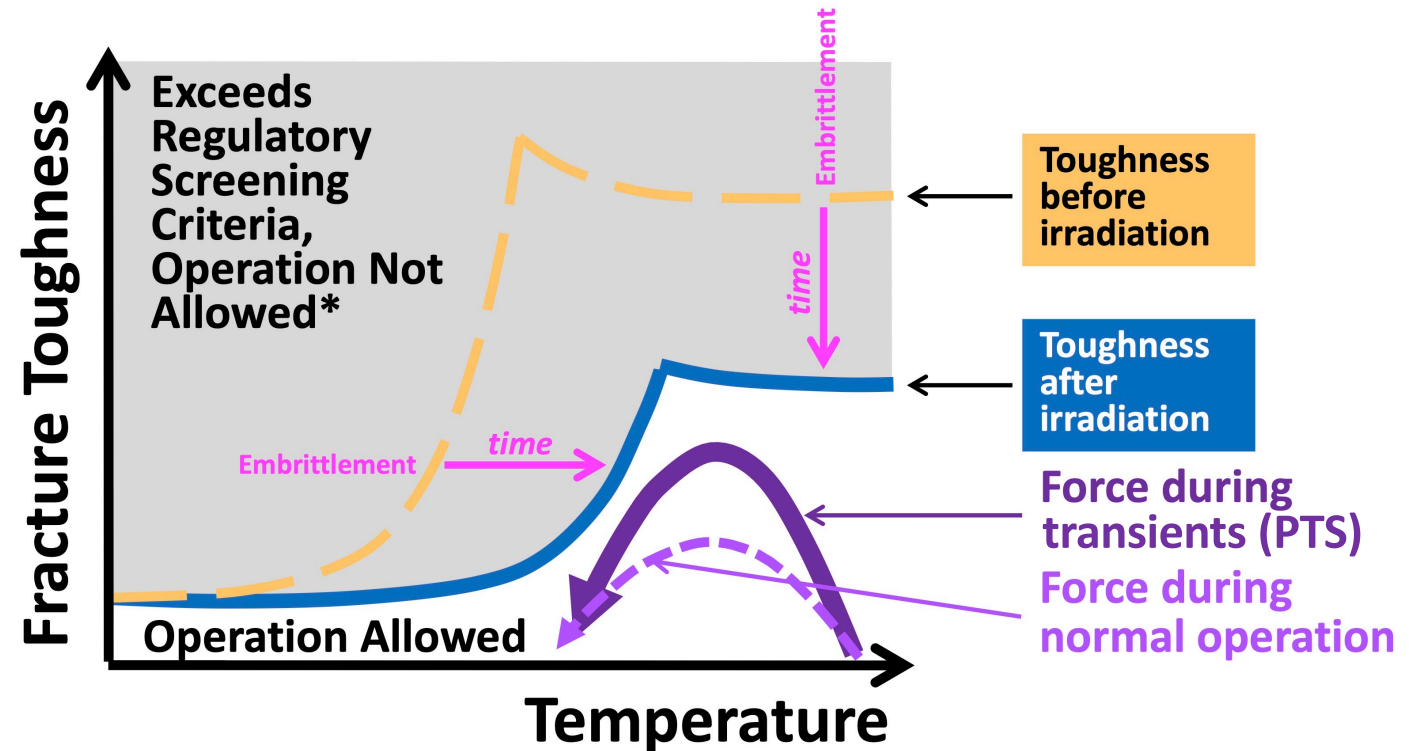
Capsule data & predictive model forecast future RPV embrittlement

Both surveillance data and T_{41J} model are used to forecast future embrittlement



Assessment of RPV Integrity

- Screening criteria ensure material resistance to fracture exceeds structural driving force
 - Pressure-Temperature operating limits
 - Per ASME Code (shown)
 - Pressurized thermal shock
 - $RT_{PTS} < 132\text{ }^{\circ}\text{C}$ for axial welds
 - Upper shelf energy
 - $USE > 68\text{ Joules}$



* - not allowed without additional justification, plant modification, or testing

Screening criteria

- Are not a failure condition
 - Are conservatively established at a low failure probability
 - Indicate need for additional actions to demonstrate adequate margins
- NRC requires action plan 3 years in advance

2. NRC Requirements & Guidance

Part 1 Report
Section 2.4 and 2.5

Embrittlement monitoring & prediction

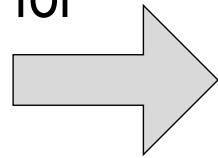
- 10CFR 50 App. H
- RG 1.99 Rev 2
- NUREG-1801

RPV Integrity

- 10CFR 50 App. G
- 10 CFR 50.61
- 10 CFR 50.61a

Embrittlement Monitoring

- NRC 10CFR50 Appendix H sets requirements for surveillance during the initial 40-year license. Incorporates ASTM standard by reference
 - Unit 1 licensed to ASTM E185-70, which requires 3 capsules
- NUREG-1801: NRC recommendations for license renewal (beyond 40 years)
 - Compliance with E185-82 recommended
 - More capsules needed during license renewal if
 - Highest fluence is < 60-year fluence, or
 - The ΔT_{41J} predicted at 60-years increases the number of capsules per ASTM E185-82 table
 - These recommendations suggests a 4th capsule for Unit 1 between 40-60 years



ASTM E185-82

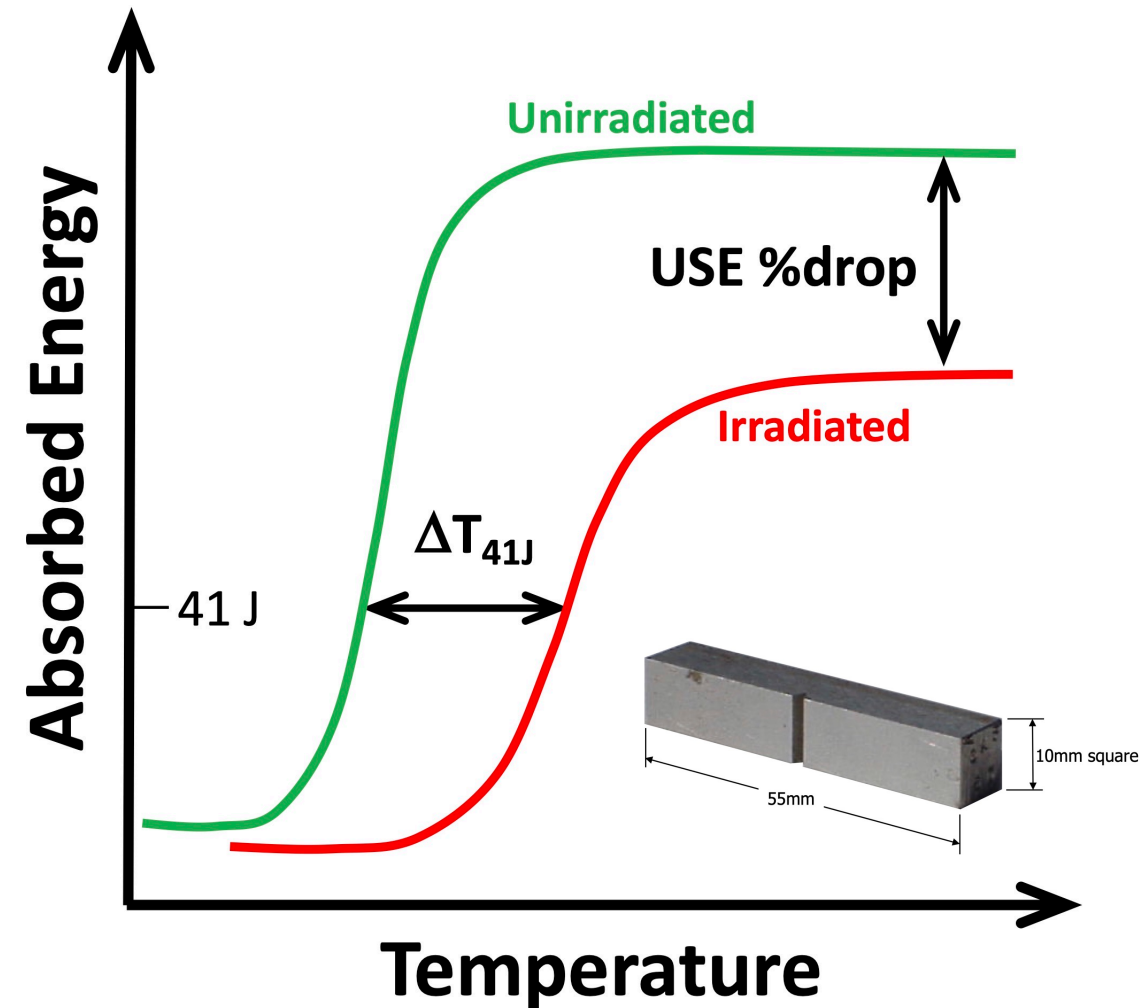
Predicted ΔT_{41J} on Vessel ID at EOL Fluence [°C]	# of Capsules Required
< 56 °C	3
56 - 111 °C	4
> 111 °C	5

- Last capsule withdrawn between 1x & 2x EOL fluence
- Monitoring of limiting plate and limiting weld required

- Diablo Canyon Unit 1 licensed to E185-70
- 3 capsules required in first 40 years
- During license renewal 1 more capsule is recommended

Embrittlement Prediction

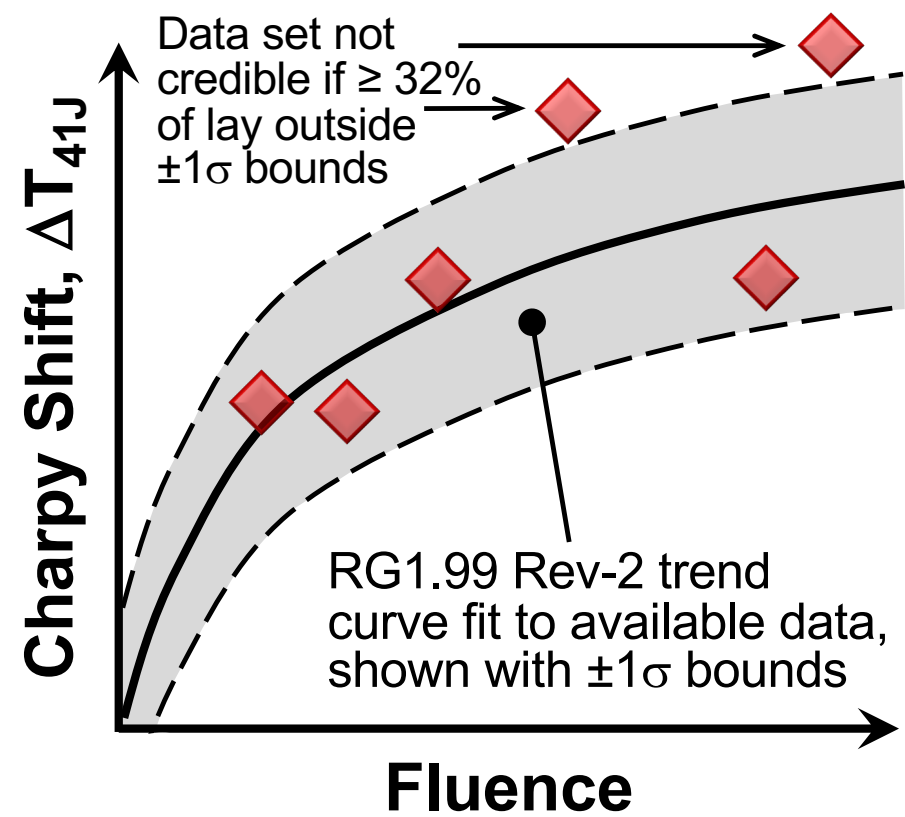
- Reg Guide 1.99 Rev 2 provides NRC's embrittlement prediction models
- Formulas estimate ΔT_{41J} and %drop of USE
- The ΔT_{41J} formula (reference temperature shift)
 - Is required by the PTS rule (10CFR 50.61)
 - Is used by custom for P-T limits (ASME Code)
 - Alternate PTS rule (10CFR50.61a) requires a different model
- Guidance and requirements for what data to use are provided (“credibility”) ... next slides



Embrittlement Prediction (Credibility)

- Guidance and requirements for what data to use are provided (“credibility”)

What is credibility?	Credible data follows RG predicted trends
	Not credible data deviates from these trends (see diagram)*



Total # of ΔT_{41J} Measurements	# of data allowed outside shaded bounds in a credible data set
2-3	0
4-6	1
7-9	2
10-12	3

* This is one of RG1.99’s five credibility criteria. Unit 1’s compliance with this criteria has been questioned.

Embrittlement Prediction (Credibility)

- Guidance and requirements for what data to use are provided (“credibility”)

What is credibility?	Credible data follows RG predicted trends
	Not credible data deviates from these trends (see diagram)
How is credibility assessed?	On the whole dataset (all data is either credible or not credible)
	Different rules apply to ΔT_{41J} and USE %drop data
Why does credibility matter?	Credible data are used to adjust ΔT_{41J} and USE %drop predictions
	Not-credible data are modeled more conservatively using RG formulas
What data are used?	For PTS, use of plant-specific data and similar data from “sister plants” is required. P-T limits follow this practice by convention, not requirement.
	For USE assessment, 10CFR50 Appendix G makes no statements about “sister plant” data. Sister plant data is not typically used.

RPV Integrity Screening Criteria

Event	NRC Rule	Mechanical Property	Screening Criteria
Pressure-Temperature Limits for Heat Up and Cool Down	10 CFR 50 App G	USE	USE > 68J
Pressurized Thermal Shock	10 CFR 50.61	ΔT_{41J}	NRC Incorporates ASME Code: Section XI, Appendix G
	10 CFR 50.61a		• Axial Weld $RT_{PTS} < 132\text{ }^{\circ}\text{C}$ • Plate or Circ Weld $RT_{PTS} < 149\text{ }^{\circ}\text{C}$



Screening criteria

- Are not a failure condition
- Are conservatively established at a low failure probability

TABLE 1—PTS SCREENING CRITERIA

Product form and RT _{MAX-X} Values	RT _{MAX-X} limits [°F] for different vessel wall thicknesses ⁶ (T _{WALL})		
	T _{WALL} ≤ 9.5 in.	9.5 in. < T _{WALL} ≤ 10.5 in.	10.5 in. < T _{WALL} ≤ 11.5 in.
Axial Weld RT _{MAX-AW}	269	230	222
Plate RT _{MAX-PL}	356	305	293
Forging without underclad cracks RT _{MAX-FO} ⁷	356	305	293
Axial Weld and Plate RT _{MAX-AW} + RT _{MAX-PL}	538	476	445
Circumferential Weld RT _{MAX-CW} ⁸	312	277	269
Forging with underclad cracks RT _{MAX-FO} ⁹ ...	246	241	239

3. Diablo Canyon Unit 1 Evaluation

Part 2 Report
Sections 2, 3, and 4

Surveillance Program

- Program status
- Capsule B deferrals

Evaluation based on NRC requirements

Supplemental Evaluation

Diablo Canyon Unit 1 Surveillance Program

- Program licensed to ASTM E185-70
 - 3 capsules over 40-years
 - Requirements fulfilled in 2002
- Capsule B deferrals have been appropriate because only 3 capsules required in first 40-years
- During license renewal
 - 1 more capsule is now recommended
 - Testing of Cap-B planned for the next refueling outage (2025), recommended before 2028
- Palisades “sister plant” data incorporated in 2011, provides 60+ year fluence data

Capsule ID	Lead Factor	Removal Year	Status
S	3.46	1986	Tested
Y	3.44	1992	
V	2.26	2002	
T	3.44	1992	Removed, Not Tested
Z	3.44	1992	
U	1.28	TBD	Standby
X	1.28	TBD	
W	1.28	TBD	
A	1.31	TBD	
B	3.46	2025	Planned Removal & Testing
C	3.46	2004	Removed, Not Tested
D	3.46	2004	

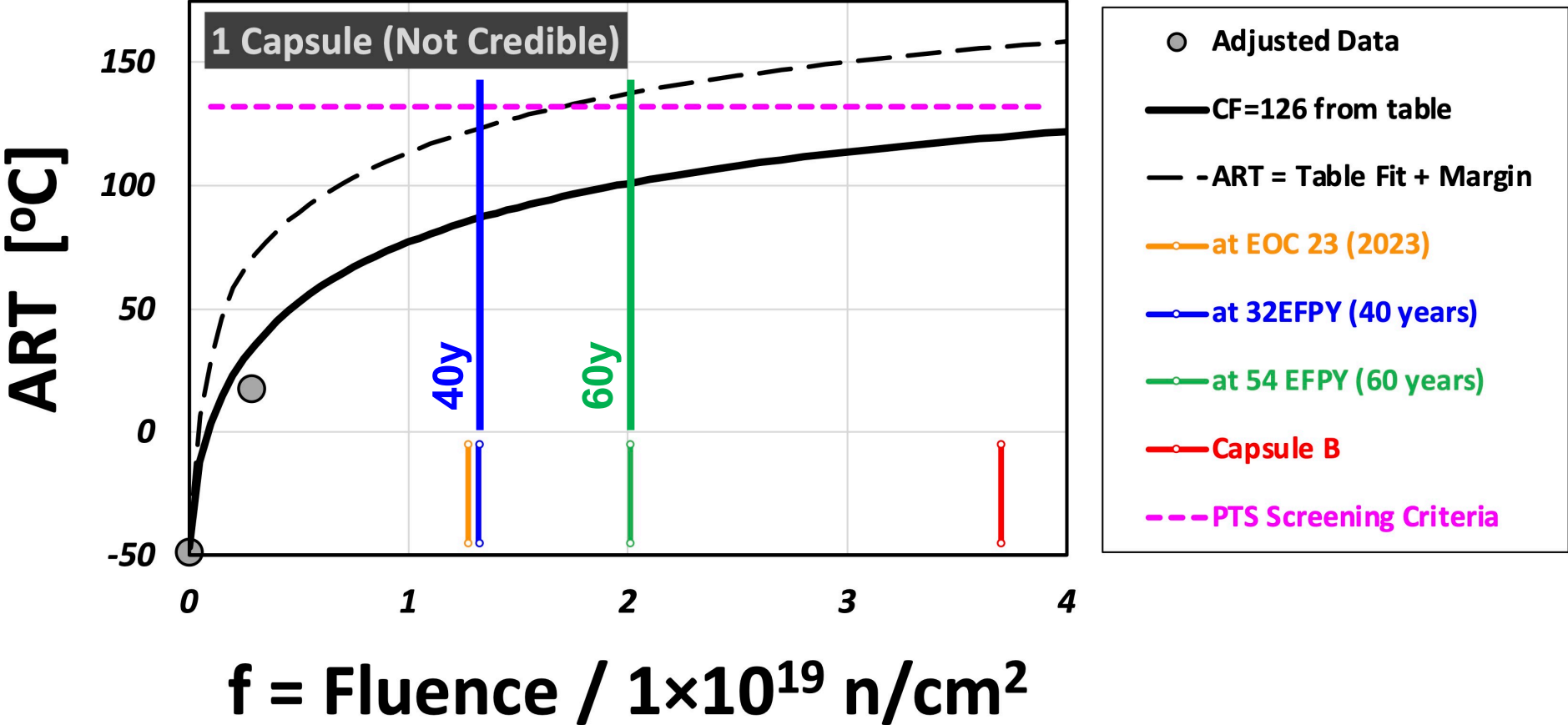
Contains limiting weld

- Capsule B deferrals appropriate during first 40 years
- Capsule B testing recommended by 2028
- Once obtained, Capsule B data may alter PTS and USE assessments

NRC Required Analysis for PTS

Not enough data

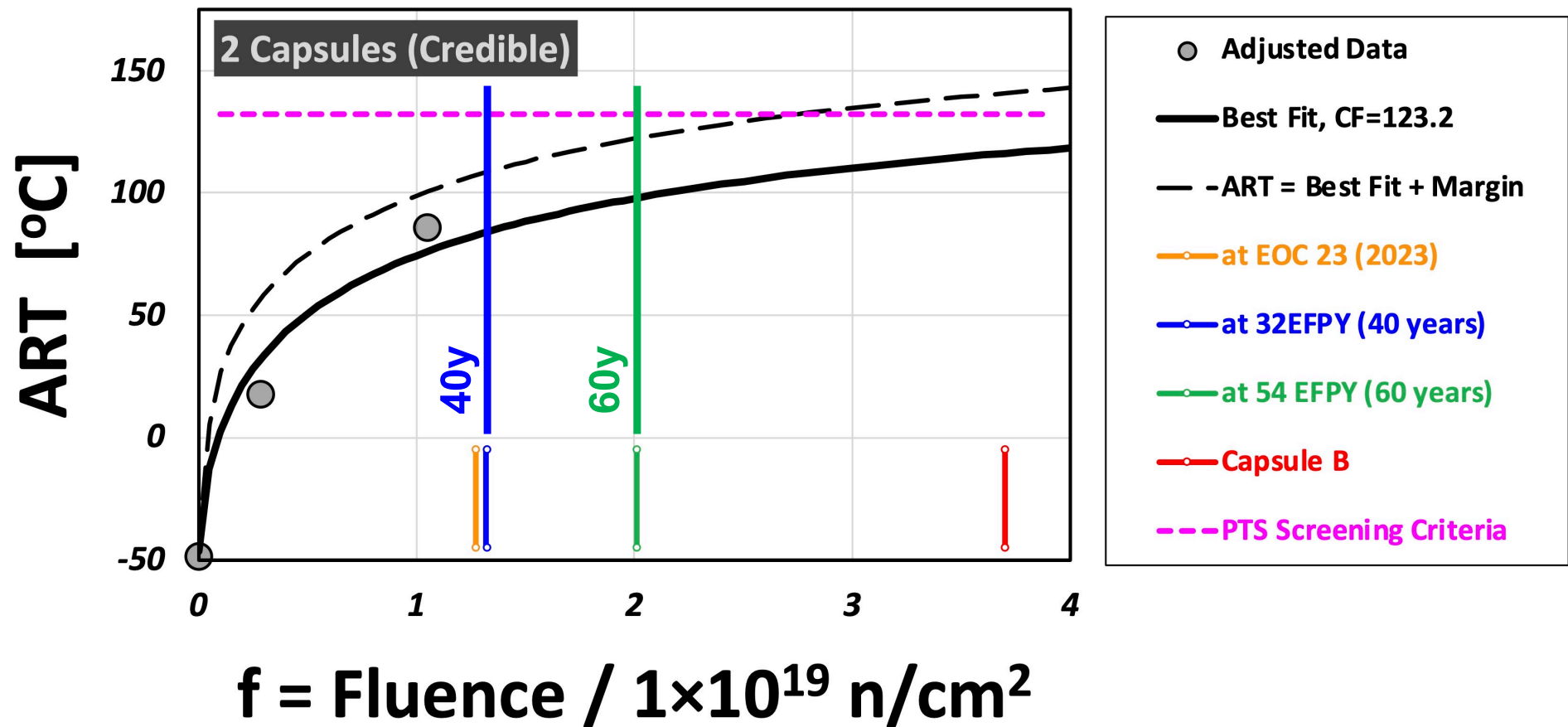
<u>Years</u>	<u>Capsules</u>	<u>Credible?</u>
1985-1987	0	No
1987-1993	1	



NRC Required Analysis for PTS

Enough data & scatter within limits

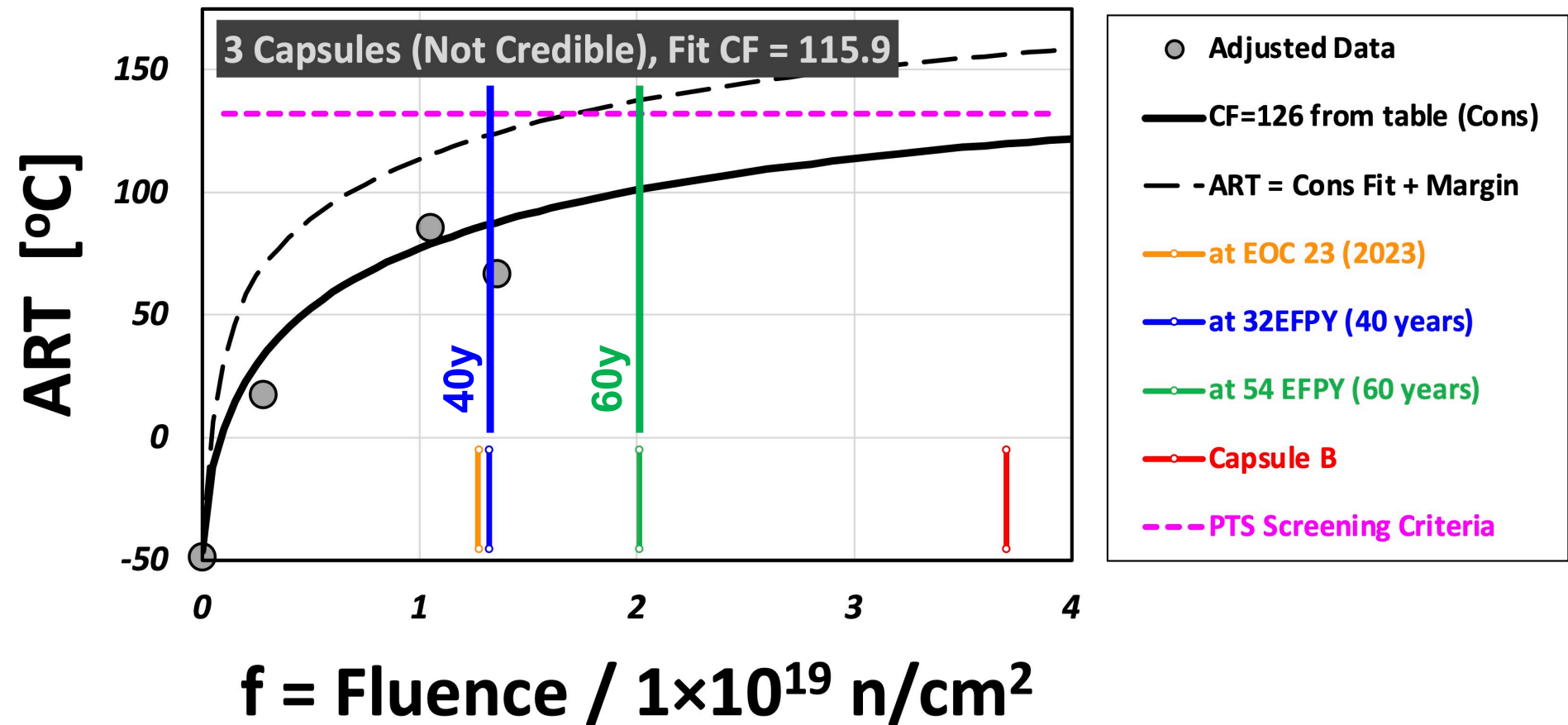
<u>Years</u>	<u>Capsules</u>	<u>Credible?</u>
1993-2003	2	Yes



NRC Required Analysis for PTS

Enough data but
scatter exceeds
limits

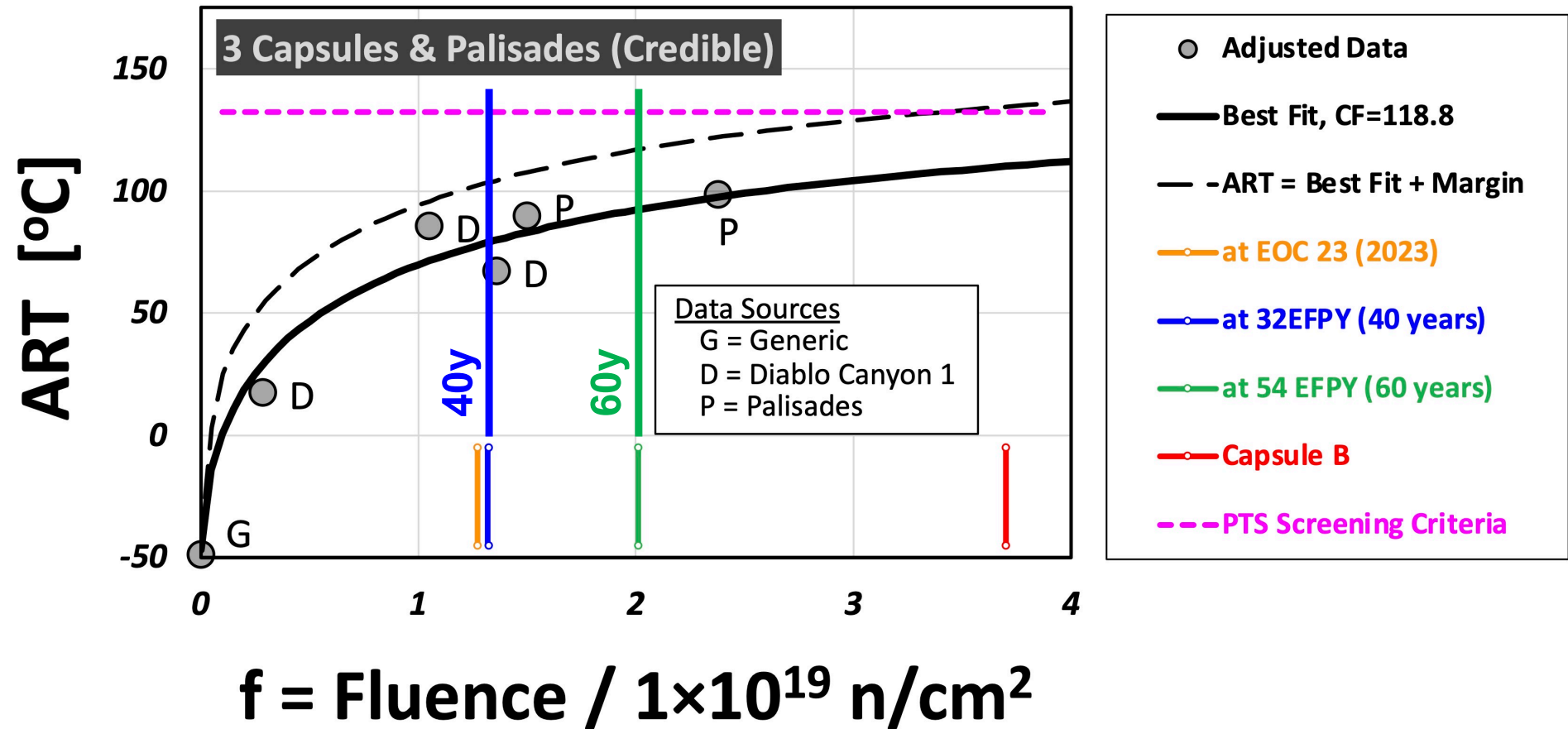
<u>Years</u>	<u>Capsules</u>	<u>Credible?</u>
2003-2011	3	No



NRC Required Analysis for PTS

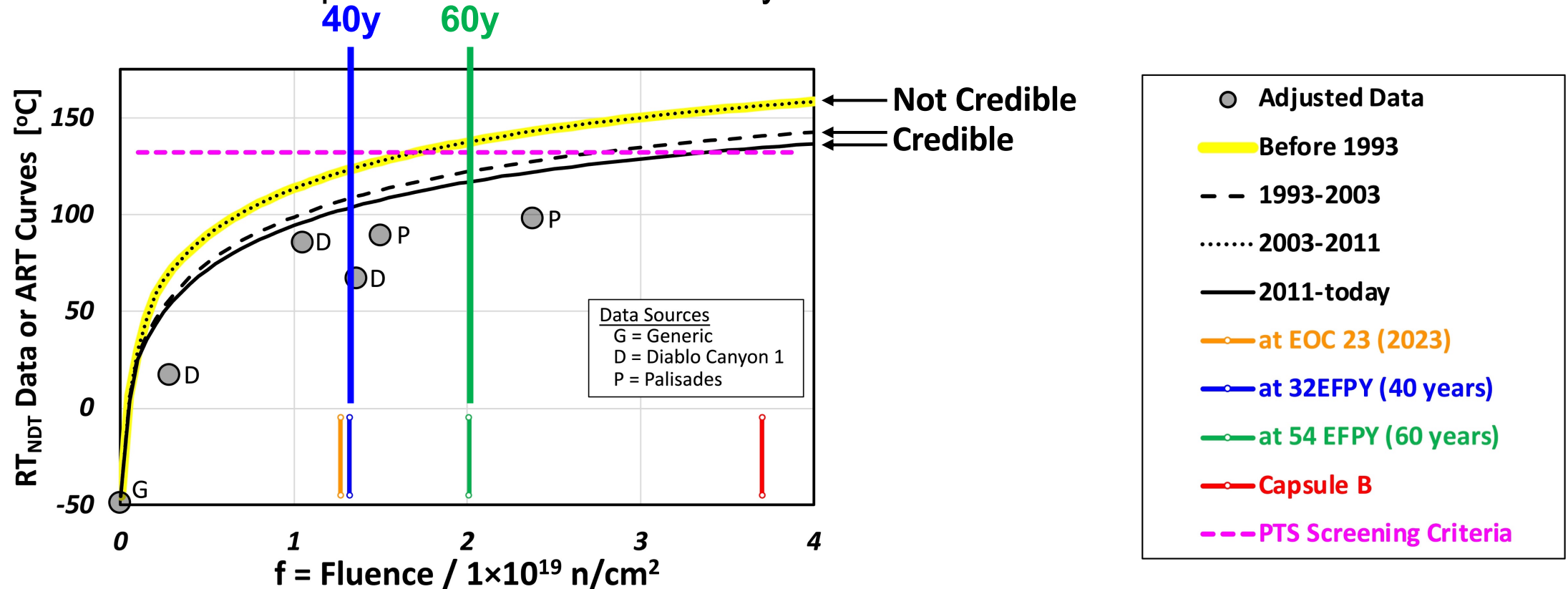
Enough data & scatter within limits

<u>Years</u>	<u>Capsules</u>	<u>Credible?</u>
2011-now	3+Palisades	Yes



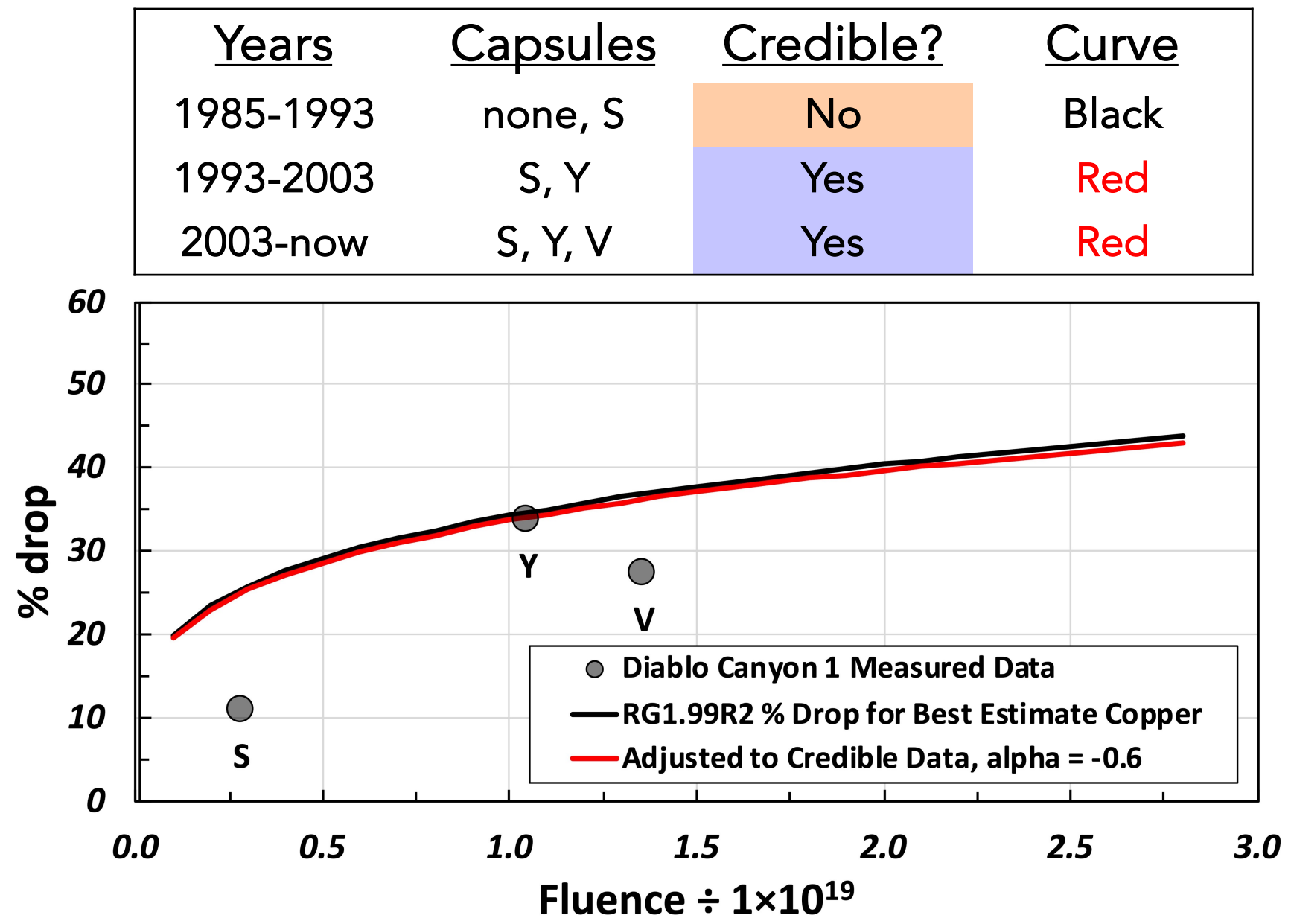
NRC Required Analysis for PTS, Summary

- My calculations fully validate those performed by PG&E, including both estimated reference temperature values and credibility status
 - When **not-credible** the 10CFR50.61 PTS screening criteria is exceeded between 40-60 years due to added conservatism
 - When **credible** the 10CFR50.61 PTS screening criteria is not exceeded until well past 60 years
- The same trend curve represents both Diablo Canyon and Palisades data well



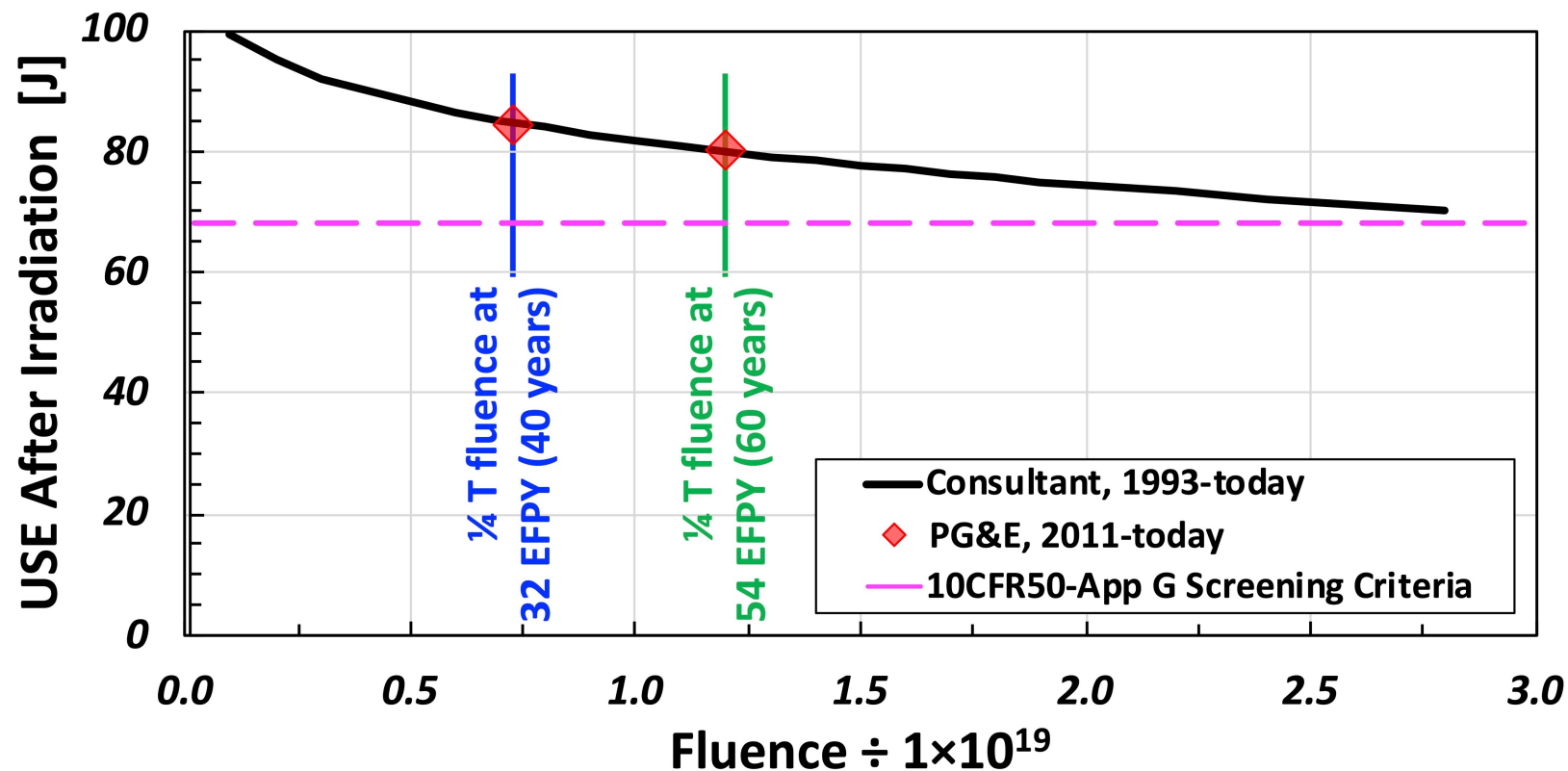
NRC Required Analysis for USE

- NRC requires that the RG1.99 model (black curve) be adjusted to bound all credible data (red curve)
 - For Unit 1 the adjustment is minor
- NRC is silent on the use of similar sister plant data for USE assessments
 - USE data from sister plants not typically used



NRC Required Analysis for USE

- This analysis suggests that Unit 1 will not fall below NRC's 68J screening criteria until long after 60 years
- My calculations validate those of PG&E from 2011 until today
 - PG&E made a small error in 2003 on credibility assessment for USE. This was identified in an NRC “request for additional information” and corrected
 - Error was in conservative direction. Negligible impact on prediction.



Supplemental Analysis

Objective

Use more data and more modern analytical techniques* to help inform judgements concerning

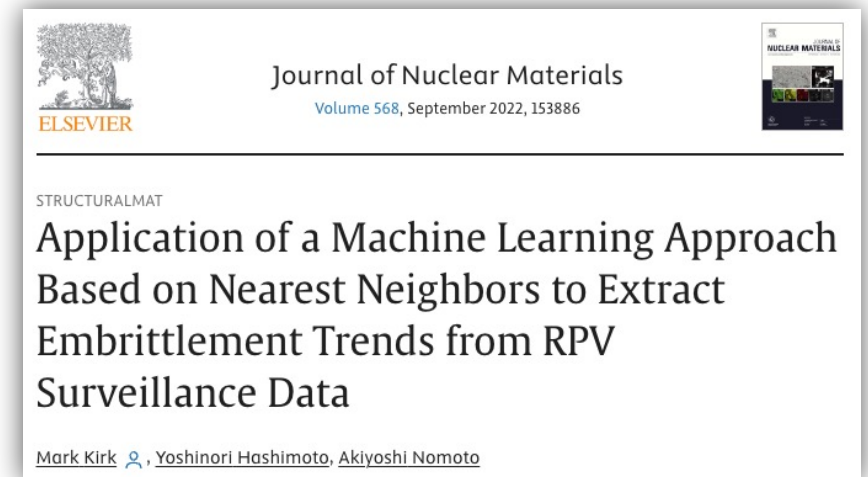
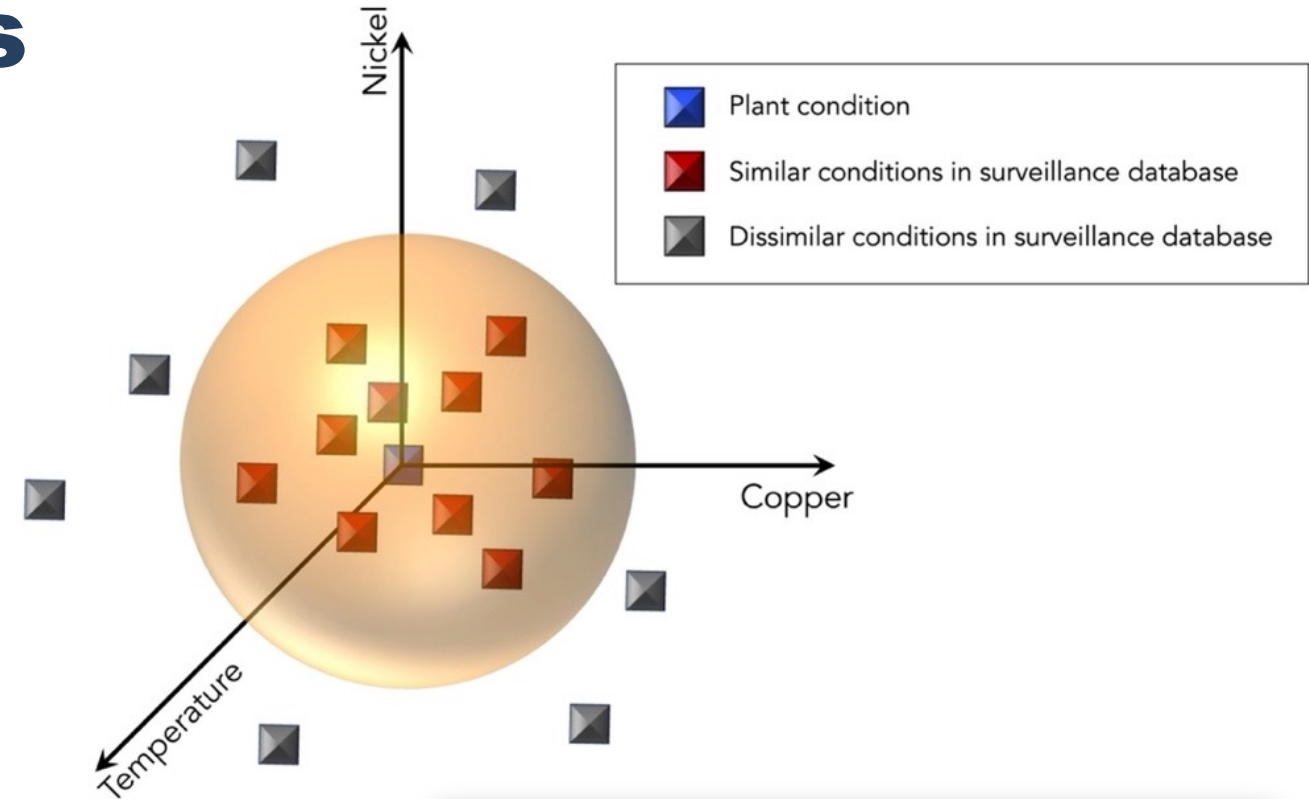
- Confidence in existing techniques
- Need, or not, for additional testing and analysis

* Techniques not yet endorsed by ASME or NRC

Supplemental Analysis

More Data

- Used a machine-learning inspired technique to identify data with similar embrittlement characteristics to the Unit 1 weld
 - Intent is the same as for “sister plants,” but based on more objective / physically based similarity metrics
 - Similarity based on copper, nickel, and irradiation temperature
 - Used international ASTM database

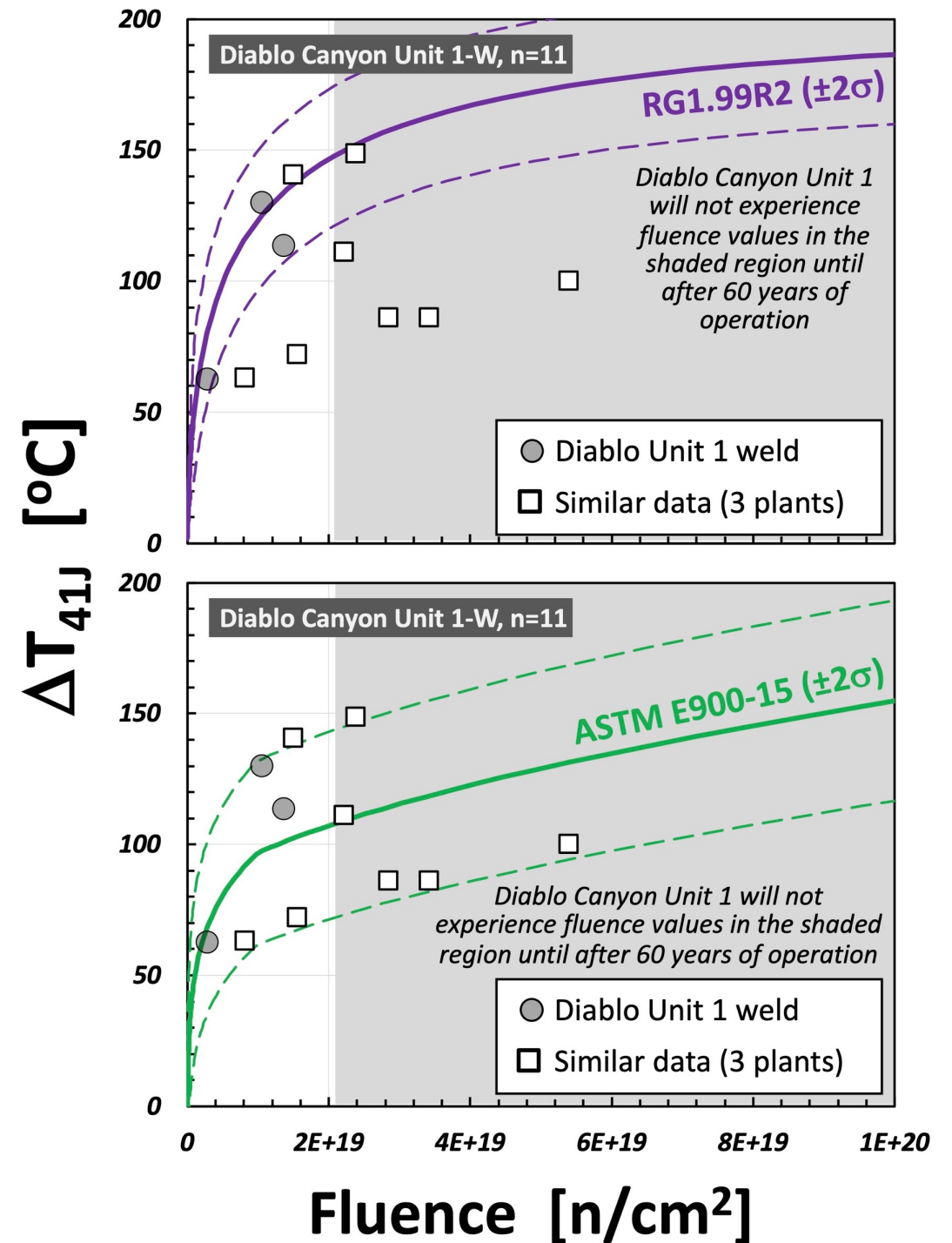


<https://www.sciencedirect.com/science/article/abs/pii/S0022311522003725?via%3Dihub>

Supplemental Analysis

More Data

- Data similar to Diablo Canyon 1 weld:
 - Palisades
 - Two PWRs in Germany
- Shows NRC curve provides a conservative representation of data similar to the Diablo Canyon Unit 1 weld



Supplemental Analysis

Modern Analytical Techniques

- For PTS and P-T limits (ΔT_{41J} data)
 - Used **draft** ASME Code Case N-914
 - Permits use of fracture toughness data (available for Diablo weld in EPRI MRP-127)
 - Permits use of a modern trend curve (ASTM E900-15)
 - **Now in review: not yet approved by either ASME or NRC**
- For USE
 - Used additional data with standard RG1.99R2 analysis process
 - Advanced techniques using fracture toughness data are available [RG1.161, ASME SC-XI App-K] but were not used in this study

DRAFT CODE CASE N-914

Section XI Record No. 19-1113

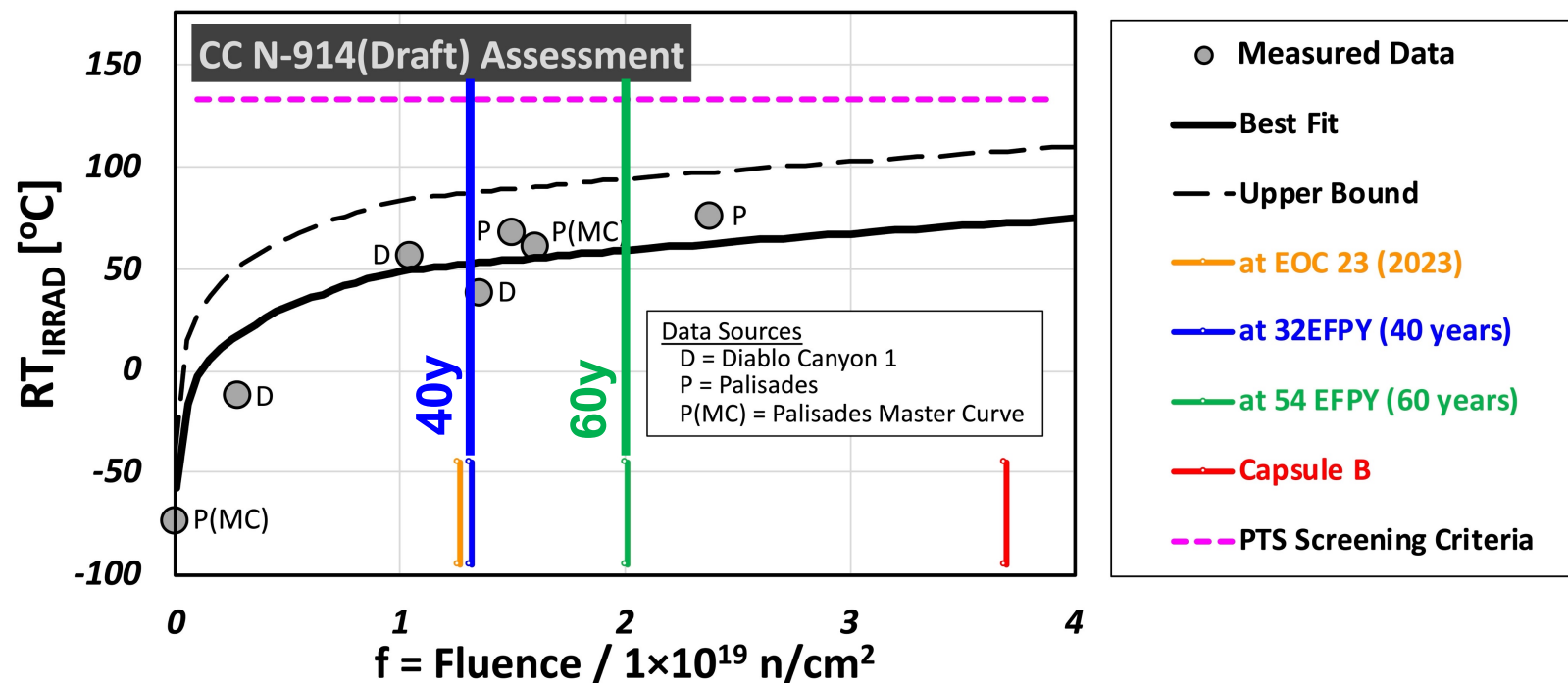
Accounting for the Effect of Embrittlement on Fracture Toughness Properties Used in Evaluations of Pressure Boundary Materials in Class 1 Ferritic Steel Components, Section XI, Division 1

<https://www.epri.com/research/products/000000003002020911>

Supplemental Analysis

PTS

- Analysis shows larger distance from the PTS screening criteria than standard NRC analysis (larger margin)
- Fracture toughness data demonstrates the level of conservatism in the current NRC approach

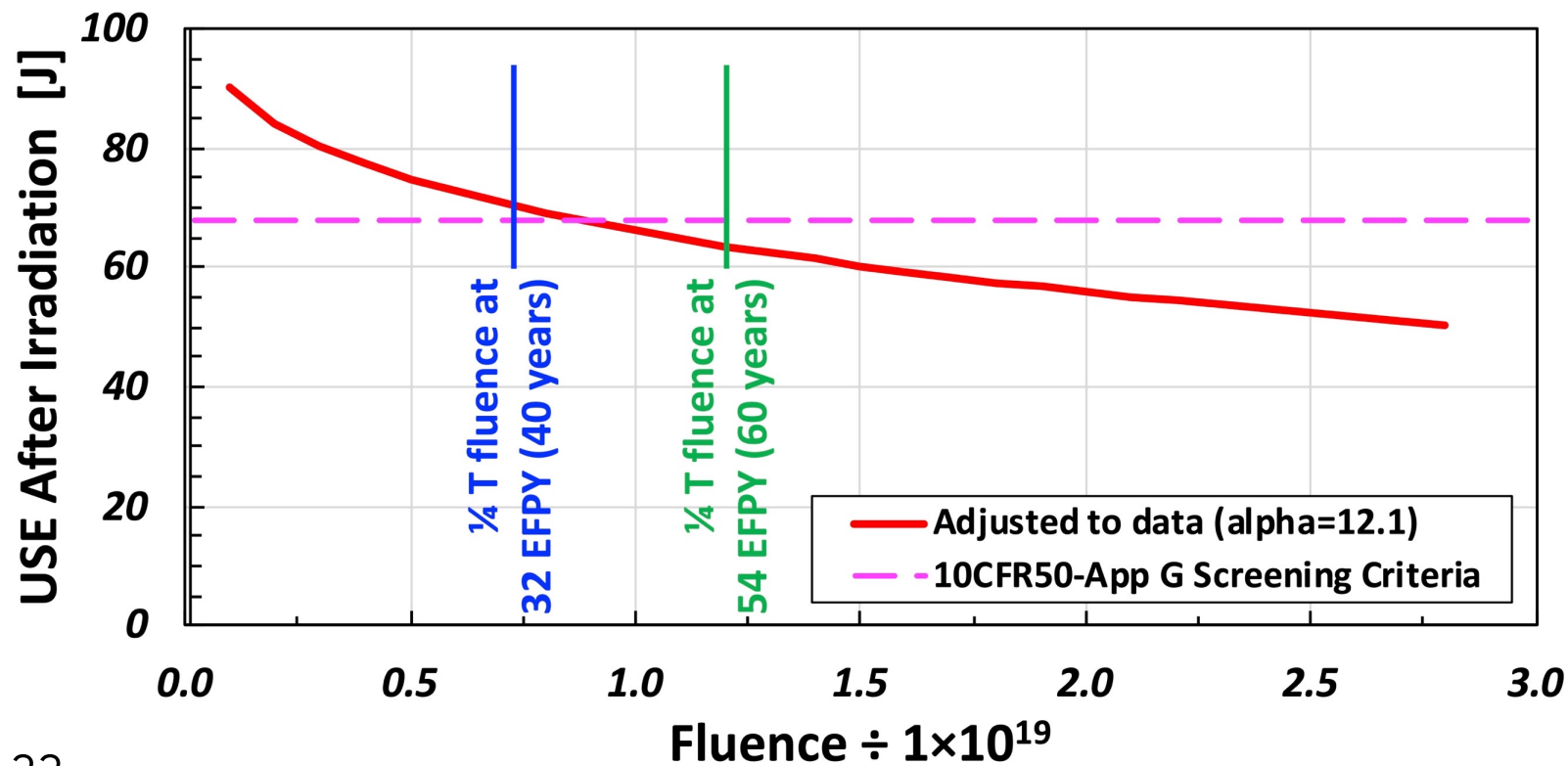


- Greater margin exists than suggested by NRC approach
- PTS screening criteria not exceeded until well after 60 years of operation

Supplemental Analysis

USE

- Consideration of similar USE data & the RG1.99R2 method suggests Unit 1 will fall below the NRC 68J screening criteria before 60 years ($\approx$ 2029-2030)
- This could be addressed by performing an “equivalent margins analysis” (EMA) following RG1.161
- EMAs performed on other plants show, without exception, the acceptability of lower USE values



- Unit 1 may fall below USE screening criteria by $\approx$ 2030
- Further analysis using RG1.161 very likely to demonstrate acceptability through 60 years
- Screening criteria are not failure conditions

4. Answers to Public Concerns

Part 1 Report
Section 3



Credibility

- **Sister Plant Data**
- **RPV beltline inspections**
- **Alternate testing methods (nano indentation)**
- **Alternative Charpy analysis method**
- **Aspects of the RPV analysis methodology**
- **Deficient materials**

Sister Plant Data

- **Concern**

- “the accumulation of damage depends upon the **temperature** history of the component, i.e., on the power level history”
- “the complex nature of radiation embrittlement ... is **idiosyncratic** to individual reactors and may change unexpectedly over time”

- **Review on sister plant data**

- Provides similar data to the plant of interest
- Required for PTS
- No guidance for USE

- **Plant **temperature** history**

- Temperature affects embrittlement
- Most time plant is at 100% power ($\approx 285\text{ }^{\circ}\text{C}$)
- Plant is at higher temperature at lower power
- 100% power temperature is used (conservative)

- **Reactor specific variables other than temperature**

- Magnitude of effect on ΔT_{41J} small
- Existing trend curves predict embrittlement in many types of light water reactors well
- **Idiosyncratic** plant-specific effects not seen

RPV Beltline Inspections

Concerns

- The **small number of indications** found by UT inspections of Unit 1 are **not plausible**. Many more flaws found in Belgian RPVs and in predictions of models (FAVOR & GRIZZLY)
 - The **UT inspection interval permitted is too long**, especially because Unit 1 is significantly embrittled
 - Material damage by **hydrogen embrittlement not considered**
- **Small number of indications not plausible**
 - Reason for flaws in Belgian reactors not plausible for Unit 1
 - FAVOR and GRIZZLY models ultra-conservative
 - Indication density in Unit 1 similar to industry experience
 - **UT inspection interval too long**
 - Embrittlement does not cause cracking
 - UT cannot detect embrittlement
 - Unit 1 inspection interval is appropriate and allowed by ASME & NRC
 - **Hydrogen embrittlement not considered**
 - No evidence of hydrogen cracking in a light water RPVs
 - The stainless-steel liner protects the RPV steel
 - Liner cracking prevented by water chemistry control (low oxygen)

Alternative Testing Methods

Concern

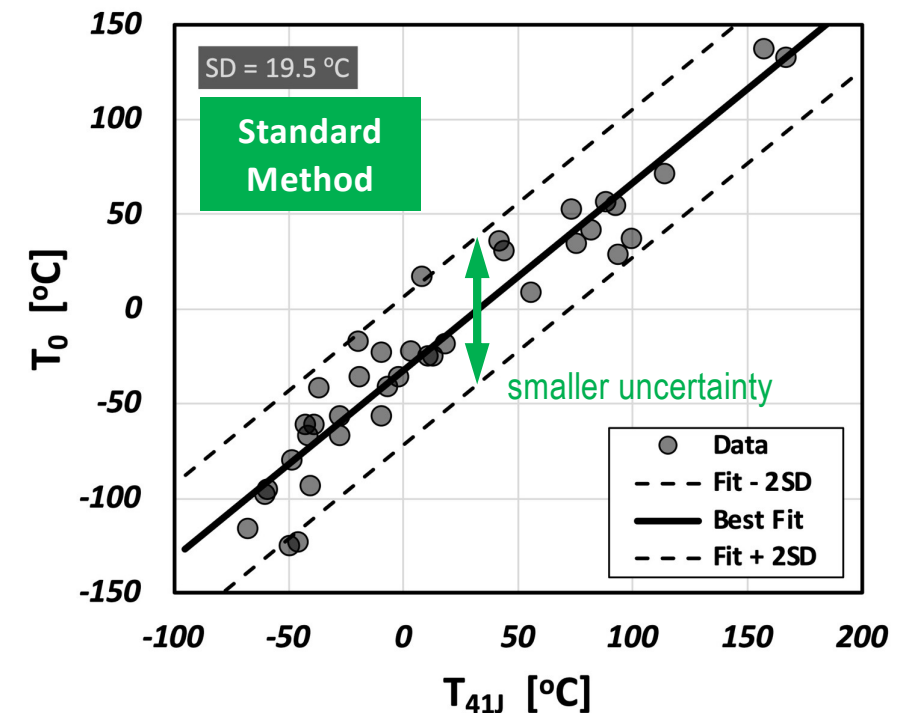
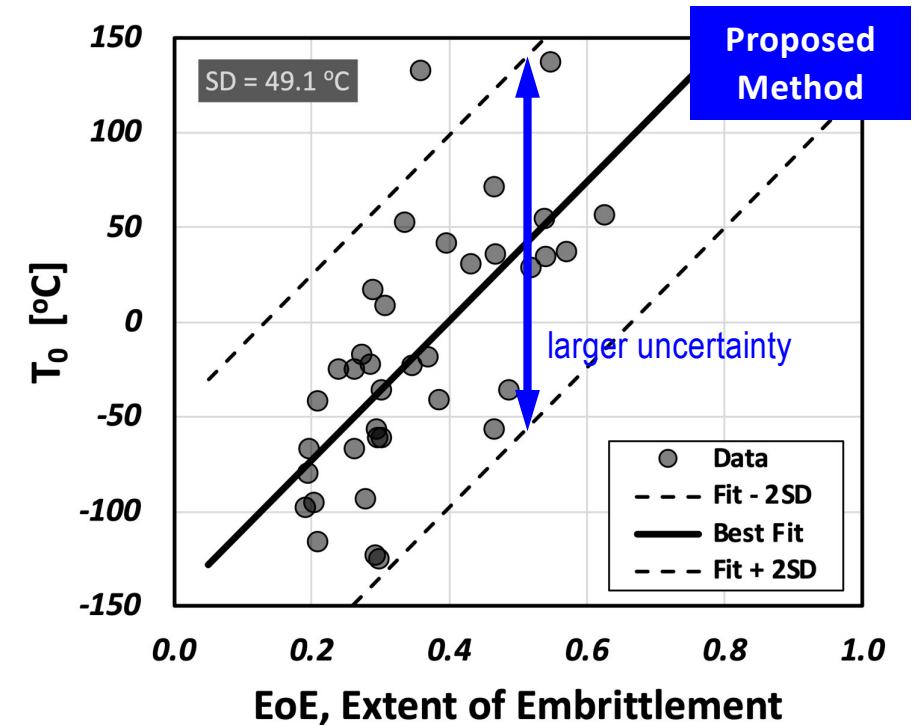
- Proposal to use Nano-Indentation data to further investigate the embrittlement status of the Diablo Canyon Unit 1 weld samples
 - Technique developed by Prof. Hosemann at UC Berkley
- Prof. Hosemann's work is well documented in the literature
 - Hardness can be related to fracture toughness using multiple correlations
 - Hardness $\rightarrow$ strength
 - Strength $\rightarrow$ fracture toughnessEach correlation introduces uncertainty to the final predicted value.
 - No precedent exists for using fracture toughness inferred from hardness in regulatory decisionmaking
 - Lack of precedent and compounding uncertainties complicates interpretation of any data collected
 - If supplemental data are needed, direct fracture toughness (T_0) testing using the “mini-CT” specimen & ASTM E1921 for which there is regulatory precedent would produce clearer outcomes

Alternative Charpy Analysis Method

- **Concern**

- Existing methodology not sufficiently accurate
- Prof. Macdonald proposed a new Charpy metric (Extent of Embrittlement: EoE)

- I assessed the accuracy of Charpy metrics (T_{41J} and EoE) by evaluating how well they predict the fracture toughness transition temperature (T_0)
- Used data from a wide variety of RPV steels before and after irradiation (see <https://doi.org/10.1115/1.3109987>)
- EoE predicts fracture toughness transition temperature less accurately than T_{41J}



RPV Assessment Methodology

Concerns

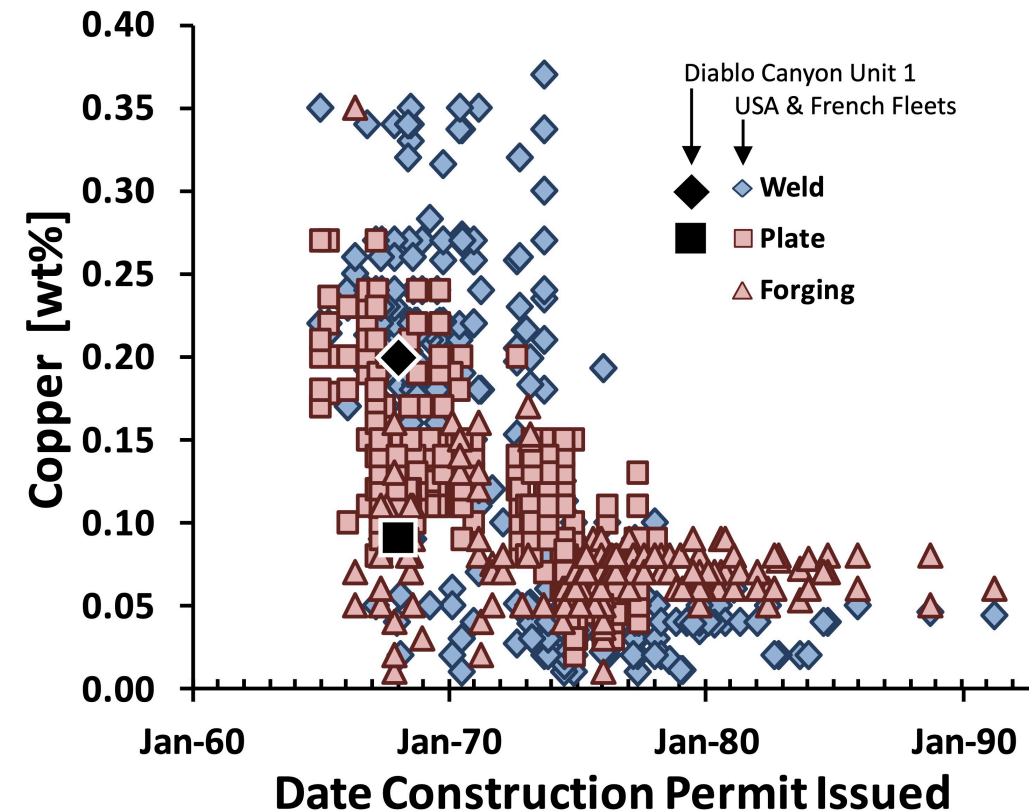
- “Why has no account been taken for the stainless-steel **liner** in determining the susceptibility of the RPV to brittle fracture & hence a LOCA?”
 - “Why has no attention been given to low temperature thermal **annealing** of radiation damage”
 - “there were still concerns expressed by PG&E ... regarding the **nozzle** shell welds [who admitted] ... that the nozzle shell welds and related components may not meet fracture toughness limits through the entire 20-year extension”
- **Cladding (liner)**
 - Defects accounted for conservatively by the PTS screening criteria
 - High toughness stainless steel cladding is ignored by structural integrity calculations (conservative)
 - **Low temperature annealing**
 - Effect quantified directly by surveillance data
 - Trend curves reflect temperature effects
 - **Accounting for steels in nozzle course**
 - Apparent misinterpretation of NRC guidance on nozzles
 - PG&E demonstrated nozzle materials do not restrict plant operability more than the beltline weld

Deficient Materials

- **Concern**

- “*There are known metallurgical flaws in the Unit 1 reactor vessel, excessive copper and nickel impurities in welds and plate metals*”
- “*It is well documented that there were engineering errors made in the metallurgical specifications of Unit 1 plate and weld alloys*”

- Unit 1 steel chemistry typical before 1973
- Specifications based on contemporary knowledge
- Embrittlement of higher copper materials accounted for
 - Plants with more copper than Unit 1 operate safely
 - 25 units with more copper than Unit 1 remain in service today



Wrap Up

Wrap Up

- **PG&E's current reactor vessel integrity calculations were confirmed and validated**
 - Unit 1 meets the NRC requirements for reactor vessel integrity through 60 years of service
 - Credibility of data was correctly assessed
 - Sister plant data was correctly used
 - Deferrals of Capsule B testing were appropriate
 - Vessel inspection schedule is appropriate
- **Capsule B is scheduled for withdrawal during the 2025 refueling outage**
 - Removal is recommended by 2028 to be consistent with NRC guidance
 - These new data may change the outcome of current RPV integrity assessments
- **Supplemental analyses performed using more data and modern analytical techniques**
 - Pressurized thermal shock: Shows NRC screening criteria very unlikely to be exceeded in 60 years
 - Upper Shelf Energy
 - Shows USE may fall below NRC screening criteria by 2029 or 2030
 - A more accurate analysis following NRC guidance is highly likely to show that acceptable margins will remain past these dates

Thank you for your time!

EXTRA SLIDES

Capsule B Deferrals Since 2003

- Testing of Capsule V in 2002 satisfied requirements of the 40-year license
- Thereafter Capsule B became optional until Unit 1 enters a period of license renewal (operation beyond 40 years)
- NRC has reaffirmed this point in their evaluation of each request for Capsule B deferral made since 2003

Planned Cap-B Removal Year (cycle)	Deferred to Year (cycle)	Reason
2009 (15)	2010 (16)	Additional exposure needed to reach 60-year fluence
2010 (16)	2012 (17)	Capsule stuck
2012 (17)	2022 (23)	Participation in industry program to collect high fluence data
2022(23)	---	Not removed due to plans for shut down in 2024 (no 60-year operation, capsule not needed)
2022(23)	2023 (24) or 2025 (25)	State of California directed plant to pursue license renewal. Capsule again needed.
2023(24)	2025 (25)	Capsule stuck

Capsule B Testing Plan

- PG&E plans to remove Capsule B during the 25th refueling outage in 2025
 - Removal of core barrel from reactor provides more options and added certainty for successful capsule removal (increased access to the capsule holder)
- In the event Capsule B cannot be removed in 2025
 - Removal is needed by ≈ 2028 to be consistent with NUREG-1801 guidance on maximum fluence value
 - Capsule D could be re-inserted. It would take ≈ 9 years to reach a 60+ year fluence
- Once available Capsule B data will be analyzed with other available data.
 - New results may change PTS and USE assessments.
 - If screening criteria are exceeded before 60 years compensatory actions would be required
 - Possible actions: changes to plant operations, additional analysis, additional data, ...
 - NRC reviews planned actions 3 years before criteria are exceeded

Diablo Canyon Power Plant

Updates on Reactor Vessel Neutron Embrittlement

Presented by

February 21, 2024

Philippe Soenen, Director, Strategic Initiatives



- **Overview of License Renewal Application (LRA)
Reactor Vessel Neutron Embrittlement Discussion**
 - **Reactor Vessel Surveillance Coupon Withdrawal Plans**
- **Recent Attempt to
Withdraw Unit 1
Surveillance Capsule B**



Internal



Key Takeaways

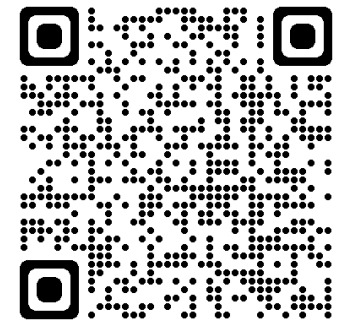
- **DCPP's reactor integrity program is in full compliance with federal safety oversight regulations**
- **DCPP License Renewal Application (LRA) includes the basis for PG&E's conclusion that the reactor vessels will remain safe for 60 years of operation using currently available information**
- **Nuclear Regulatory Commission (NRC) will independently review the LRA**
- **PG&E is planning to safely withdraw Unit 1 Capsule B in Spring 2025 and test it to support a commitment in the DCPP LRA**

Background

- **During plant operation, neutron irradiation over time (fluence) can reduce the fracture toughness of ferritic steel in the reactor vessel beltline region**
- **To support 40 years of operation (i.e., current operating licenses), licensees are required to reduce the potential for negative effects from neutron embrittlement by developing pressure temperature (P-T) limit curves – limits on how systems are operated**
 - These P-T limit curves are developed and updated through numerous tests and calculations in accordance with NRC regulations
 - P-T limits are required by the DCCP Technical Specifications (part of the operating licenses)

Background

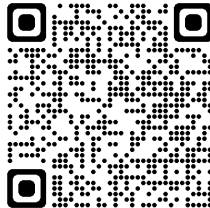
- **Federal regulations require all US operating reactors to have a Reactor Vessel Material Surveillance Program**
 - Monitor vessel material changes over time through periodic withdrawal and testing of surveillance capsules installed in the reactor vessels to ensure safe operations
- **Reactor Vessel Material Surveillance Program requirements for the current 40-yr operating period have been satisfied for Units 1 and 2 [see [ML120330497](#)]**
 - Testing to-date has demonstrated that the reactor vessels for both Units 1 and 2 currently meet the NRC's acceptance criteria



Background

- **To support license renewal, these reactor vessel neutron embrittlement calculations are updated and presented in DCPD LRA, Section 4.2, for 60 years of operation**
 - LRA Section 4.2.1, Neutron Fluence Projections
 - LRA Section 4.2.2, Pressurized Thermal Shock
 - LRA Section 4.2.3, Upper Shelf Energy
 - LRA Section 4.2.4, P-T Limits and Low Temperature Overpressure Protection (LTOP)
- **NRC independently reviews the LRA to verify DCPD Units 1 and 2 can safely operate for 60 years**

Neutron Fluence Projections

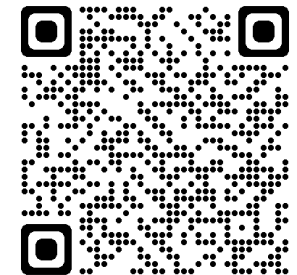
- **Surveillance coupons*** withdrawn from the DCPD reactor vessels via the Reactor Vessel Material Surveillance Program show how much fluence the materials in the vessel have experienced
 - Fluence values for 60 years of operation were calculated in accordance with NRC-approved guidance (the analysis, WCAP-17299-NP, is publicly available as part of [DCPD's LRA submittal](#)) 
 - Calculation also determined additional reactor vessel materials that should be monitored for the license renewal period (see LRA Table 4.2.1-1) – called extended beltline materials

* DCPD reactor vessels also have ex-vessel monitoring dosimetry to supplement coupon data 7



Reactor Vessel Material Surveillance Coupon Withdrawal Plans

- **Unit 2 reactor vessel coupons have all been withdrawn**
 - Data is provided in the LRA to demonstrate acceptability through 60 years of operation
- **Unit 1 reactor vessel coupons**
 - Data is provided in the LRA to demonstrate acceptability through 60 years of operation
 - LRA credits withdrawing one final coupon to support up to 60 years of DCPD operations and to benefit the industry for more than 60 years of operations
 - PG&E plans to retrieve the Unit 1 coupon in the Spring 2025 refueling outage (~101 Effective Full Power Years) as approved by NRC [[ML23199A312](#)]



Pressurized Thermal Shock and Upper Shelf Energy

- **LRA relies on NRC-approved methodologies to project PTS and USE values for 60 years of operation (called PTS reference temperature and Charpy USE)**
 - NRC regulations provide PTS reference temperature and USE screening criteria
 - The LRA provides the results of calculated PTS reference temperature and USE in accordance with NRC-approved guidance (the analysis, WCAP-17315-NP, is publicly available as part of [DCPP's LRA submittal](#)) - see LRA Tables 4.2.2-1 & 2
 - Beltline materials and extended beltline materials remained below the NRC PTS reference temperature and USE screening criteria



P-T Limits and Low Temperature Overpressure Protection

- **P-T limits are updated as required by the DCCP Technical Specifications**
 - Maintained in the Pressure Temperature Limits Report and submitted to NRC
 - Periodically updated so the P-T limits account for the anticipated reactor vessel fluence
 - Include determination of various component setpoints to support safety analyses
- **LRA commits to the existing Technical Specification requirements for managing the P-T limits throughout the period of extended operation**

Recent Attempt to Withdraw Unit 1 Capsule B

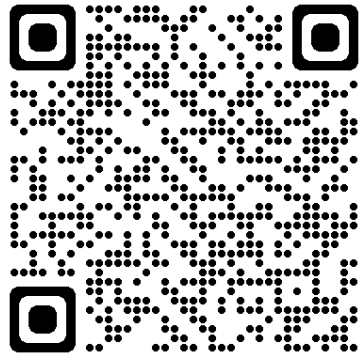




NRC-Approved Two Option Approach for Capsule B Withdrawal

- **Withdraw Capsule B in either Fall 2023 outage (1R24) or Spring 2025 outage (1R25)**

in the fracture toughness properties of the reactor pressure vessel) and (2) recommendations in NUREG-1801, Revision 2, for the period of extended operation (i.e., 60 years). Therefore, the NRC staff finds that the licensee's proposed revised withdrawal schedule for supplemental surveillance Capsule B to be tested following its withdrawal during the 1R24 or 1R25 (in fall 2023 or spring 2025, respectively) is acceptable. The NRC staff concludes that the withdrawal and testing of supplemental surveillance Capsule B supplements the requirements of the reactor vessel material surveillance program for the current license period at Diablo Canyon, Unit 1. The NRC staff notes that a report containing the test results for supplemental surveillance Capsule B must be reported to the NRC within 18 months of the capsule withdrawal in accordance with Section IV.A of Appendix H to 10 CFR Part 50.



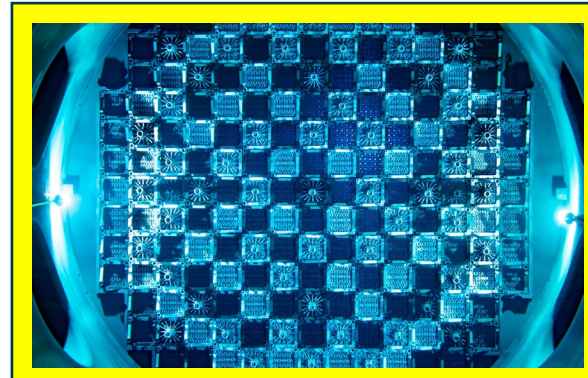
Capsule B

Two Option Approach

1R24 & 1R25 Options –
Planned and Prepared



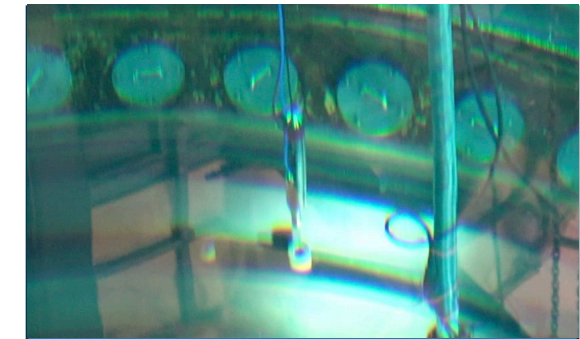
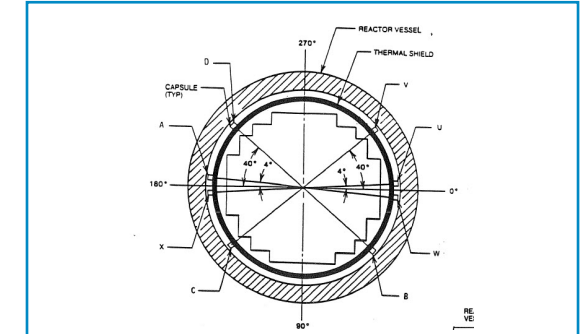
Option 1. Hand tool -
How it works



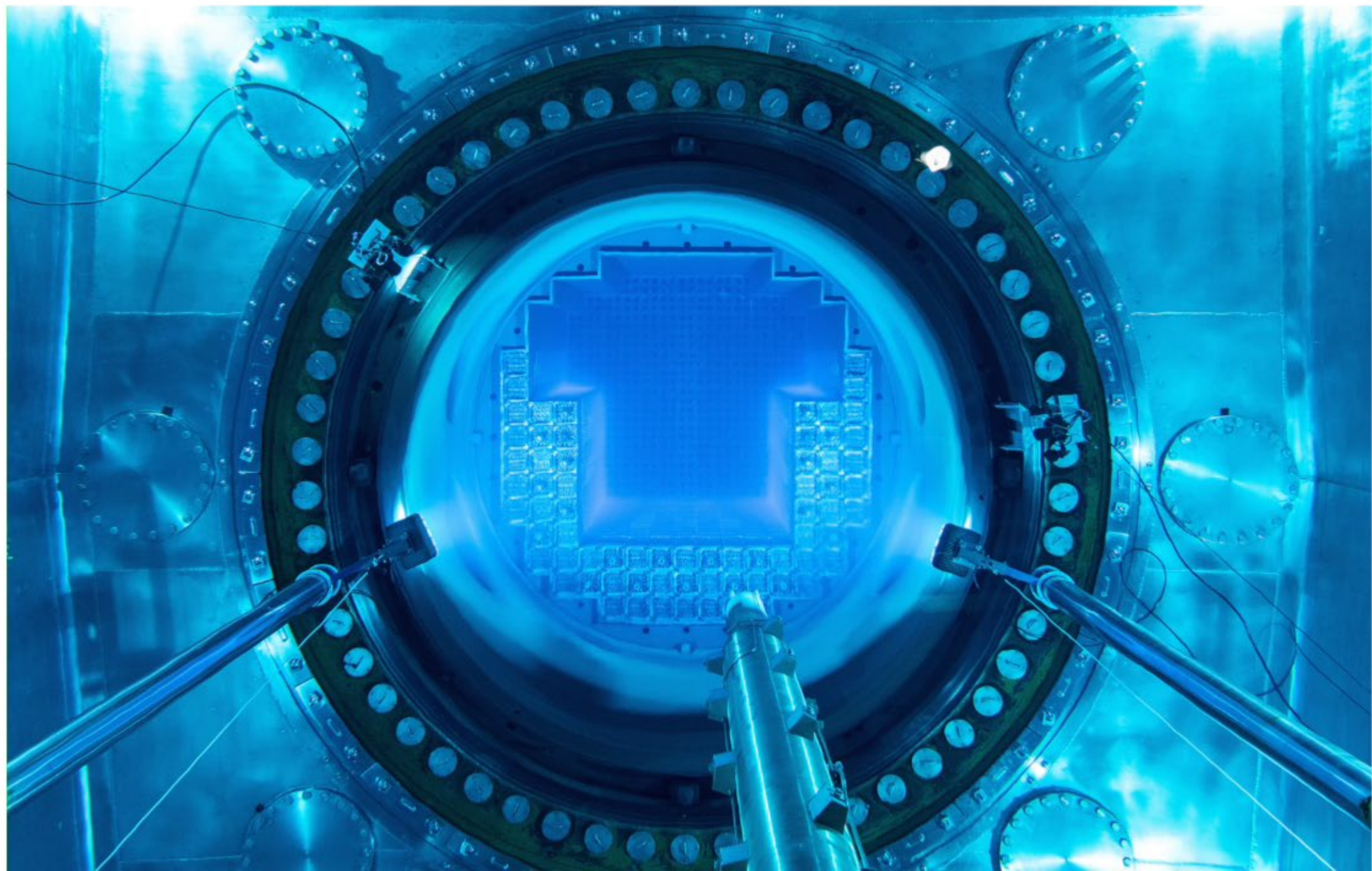
Location of Capsule B



Hand tool did not fit



Hand tool tested on two
other access plugs and fit



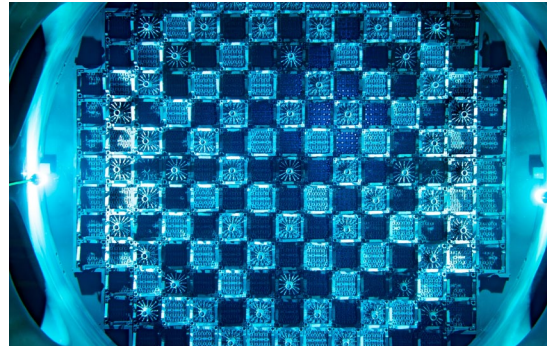
Capsule B

Two Option Approach

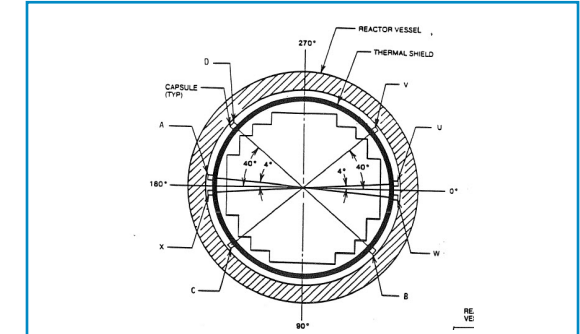
1R24 & 1R25 Options –
Planned and Prepared



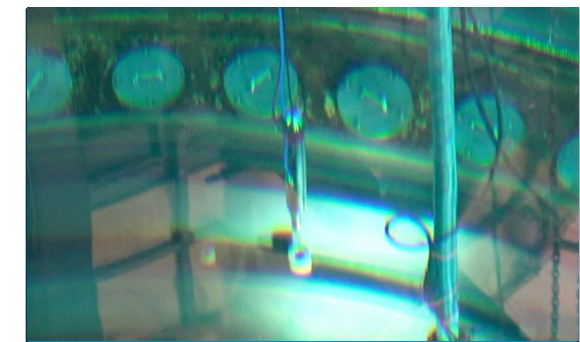
Option 1. Hand tool



Location of Capsule B



Hand tool did not fit



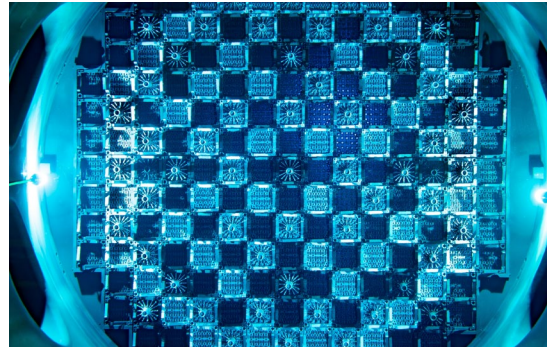
Hand tool tested on two
other access plugs and fit



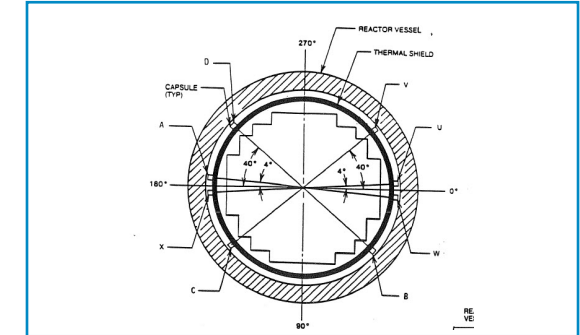
Capsule B

Two Option Approach

1R24 & 1R25 Options –
Planned and Prepared



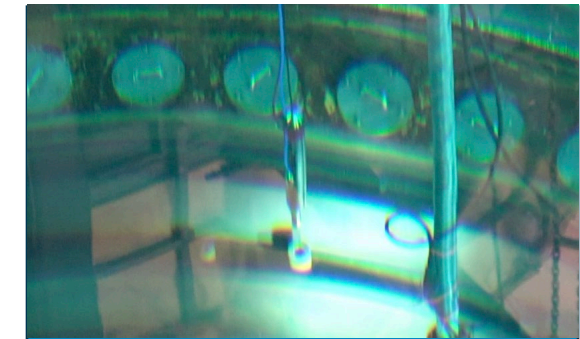
Location of Capsule B



Option 1. Hand tool



Hand tool did not fit

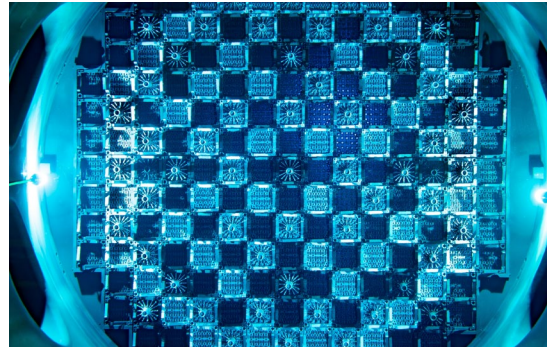


Hand tool tested on two
other access plugs and fit

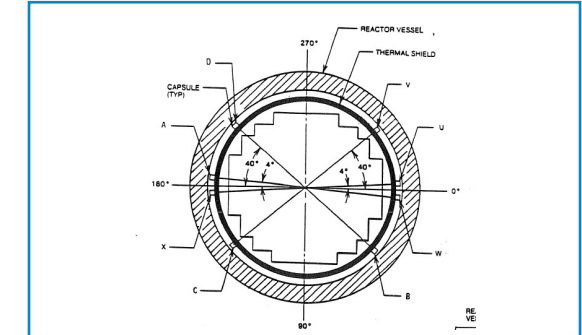
Capsule B

Two Option Approach

1R24 & 1R25 Options –
Planned and Prepared



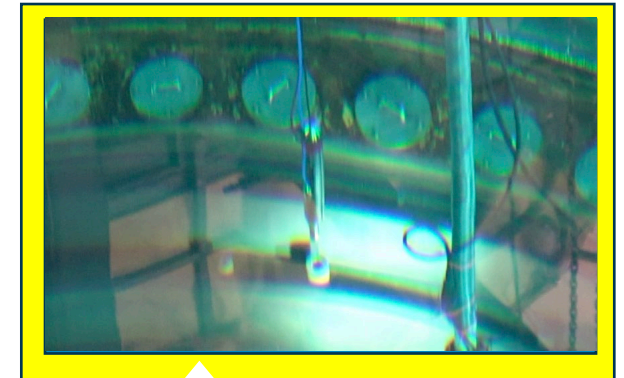
Location of Capsule B



Option 1. Hand tool



Hand tool did not fit



Hand tool tested on two
other access plugs and fit



Capsule B

Tool design is
correct

Ruled out tooling issue



Suggests deformation of
access plug on Capsule B

Rules out other options
during 1R24

Other options this outage
ruled out. (Long Pole)



Proceeding could lead to
stuck tool preventing
reassembly of core



Move Core Barrel out to a
controlled environment
during next outage

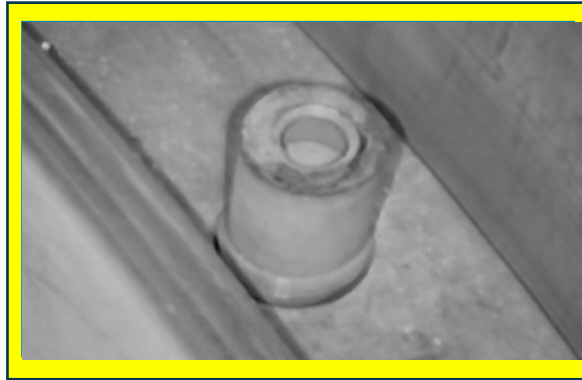


Core Barrel removal
process

Capsule B

Tool design is correct

Ruled out tooling issue



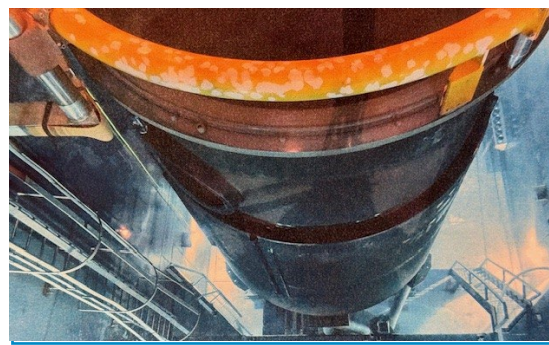
Suggests deformation of access plug on Capsule B

Rules out other options during 1R24

Other options this outage ruled out. (Long Pole)



Proceeding could lead to stuck tool preventing reassembly of core



Move Core Barrel out to a controlled environment during next outage



Core Barrel removal process



Capsule B Access Plug



Internal

Capsule B

Tool design is correct

Ruled out tooling issue



Suggests deformation of access plug on Capsule B

Rules out other options during 1R24

Other options this outage ruled out. (Long Pole)



Proceeding could lead to stuck tool preventing reassembly of core



Move Core Barrel out to a controlled environment during next outage



Core Barrel removal process

Capsule B

Tool design is correct

Ruled out tooling issue



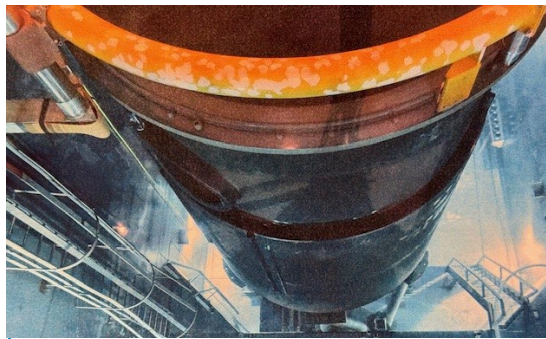
Suggests deformation of access plug on Capsule B

Rules out other options during 1R24

Other options this outage ruled out. (Long Pole)



Proceeding could lead to stuck tool preventing reassembly of core



Move Core Barrel out to a controlled environment during next outage

Internal



Core Barrel removal process

Long Tool



Capsule B

Tool design is correct

Ruled out tooling issue



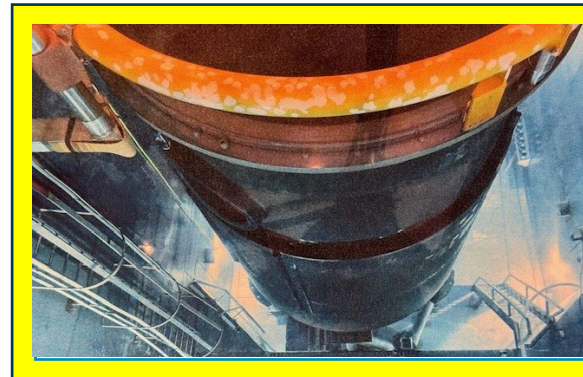
Suggests deformation of access plug on Capsule B

Rules out other options during 1R24

Other options this outage ruled out. (Long Pole)



Proceeding could lead to stuck tool preventing reassembly of core



Move Core Barrel out to a controlled environment during next outage



Core Barrel removal process



Core Barrel

Capsule B

Tool design is correct

Ruled out tooling issue



Suggests deformation of access plug on Capsule B

Rules out other options during 1R24

Other options this outage ruled out. (Long Pole)



Proceeding could lead to stuck tool preventing reassembly of core



Move Core Barrel out to a controlled environment during next outage



Core Barrel removal process



Core Barrel Removal - 2014



Conclusion



Diablo Canyon Power Plant: State of the Plant Update

Dennis Petersen

Station Director

February 22, 2024



Station Update



Plant Operation

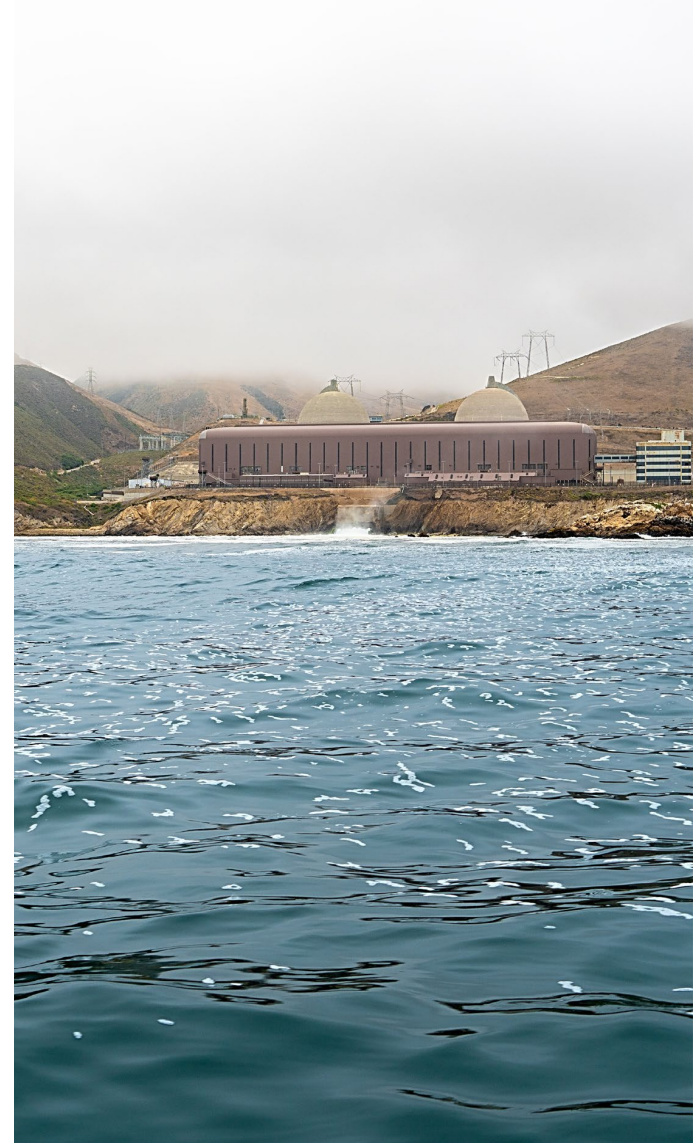
- Units 1 & 2 are safely operating at 100% power with a Probabilistic Risk Assessment (PRA) of Green
- All NRC Performance Indicators (PIs) are Green



Station Update

Recently Completed Activities

- ✓ January 16 – Unit 1 Refueling Outage (1R24) Post Outage Critique
- ✓ January 17 – Unit 2 Refueling Outage (2R24) Readiness Review
- ✓ January 22-26 – Safety Week focused on Human Performance Tools
- ✓ January 29 – Unit 2 Refueling Outage (2R24) Executive Vendor Meeting
- ✓ January 29 - February 1 – Nuclear Regulatory Commission (NRC) Cyber Security Program Inspection



Station Update

Diesel Generator (DG) Maintenance – 1st Quarter 2024

- ✓ January 29 – February 11 - DG 2-3 is Complete
- ❑ February 19 – March 3 - DG 2-1 is in progress
- ❑ March 11 – 24 - DG 2-2 is Scheduled



Station Update – Tornado warning

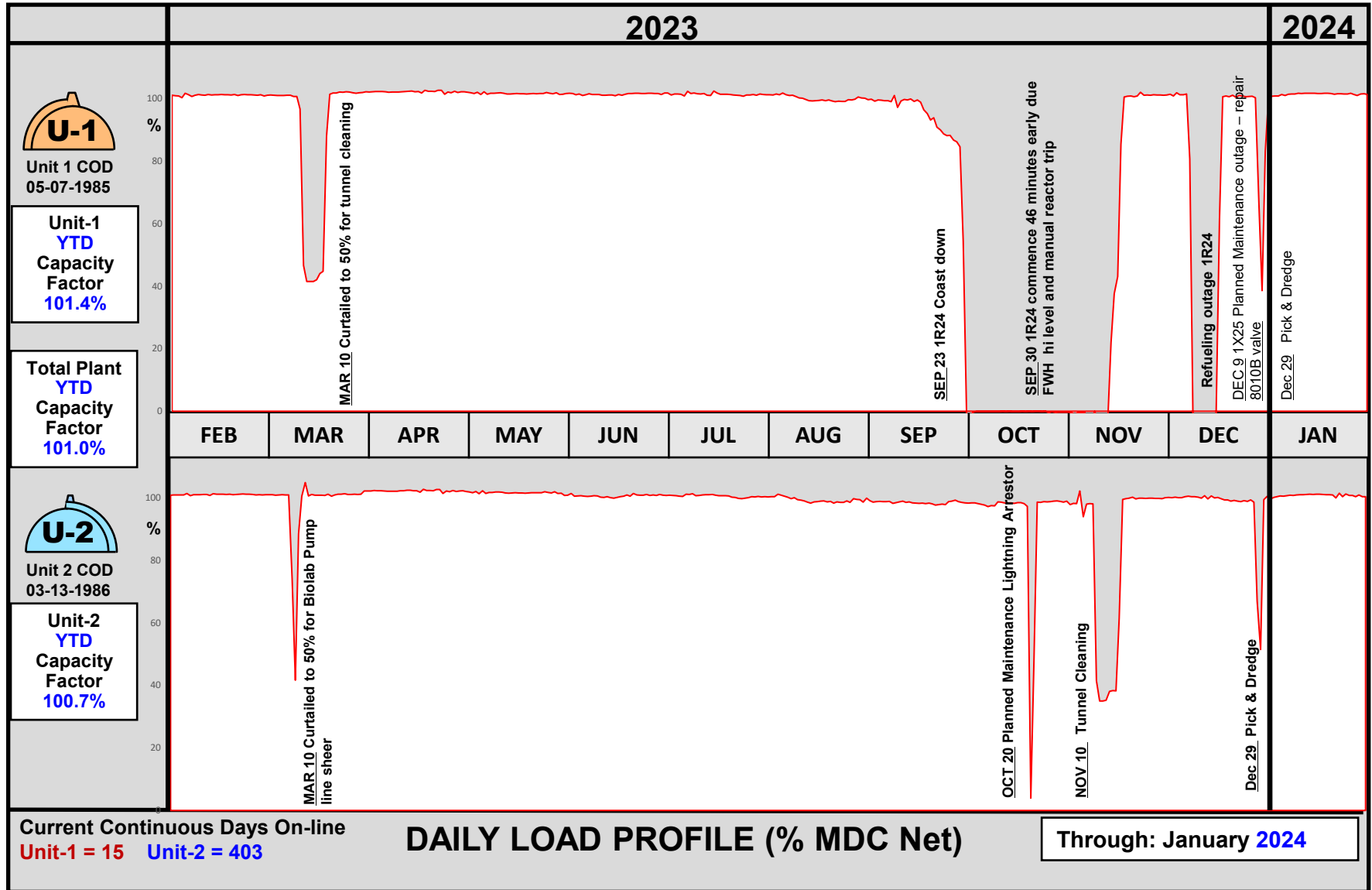
- County issued Tornado warning in the region on Feb. 7
- DCPD entered severe weather procedure (includes instructions to take shelter indoors away from doors and windows)
- DCPD is designed and licensed by the Nuclear Regulatory Commission to withstand several external hazards, including tornados
- DCPD is designed to withstand the forces of significant wind loading on buildings and the plant can be safely shut down
- The station has operating procedures, emergency plans, and additional recovery equipment for preparation and response to excessive wind and Tornado conditions





Daily Load Profile: Past 12 Months

Daily Capacity Factor Power History Curves





Upcoming Station Activities

Nuclear Safety Oversight Committee (NSOC) Site Visits

- February 26-29, 2024
- June 24-27, 2024

Upcoming NRC Inspections

- License Renewal Inspections (2R24) – April 8-26, 2024
- Inservice Inspection (2R24) – April 8-19, 2024
- Radiation Protection (2R24) – April 15-19, 2024
- License Renewal Inspection – June 17-21, 2024
- Age-Related Degradation Inspection – June 10-28, 2024

Thank You

Dennis Petersen,
Diablo Canyon Power Plant
Station Director



Diablo Canyon Outage Updates

Erik Werner
Outage Director
February 22, 2024



Summary

- 1R24 Performance, including license renewal inspection results
- 1X25 Performance
- 2R24 Preparations

Summary

- Diablo Canyon Unit 1 twenty-fourth refueling outage (1R24) safely executed during the Fall of 2023
- The 50-day planned outage encompassed scope from license renewal required inspections, planned maintenance, and refueling activities
- Approximately 1,000 temporary additional workers supported the safe completion of 1R24

1R24 Performance

Category	1R24 Goals	1R24 Performance
Safety	Zero Recordable Injuries	● Zero recordable injuries
	Zero Nuclear Safety Events	● No loss of decay heat removal
	Zero SIF Actuals/Zero SIF Potentials	● Zero SIF Actuals/Zero SIF Potentials
Human Performance	Zero HU Event Site Clock Reset	● Zero HU Events
	Zero FME Events	● Zero FME Events
Duration	≤ 50 Days	● 44 days, 8 hours, 53 minutes
Dose Goal	≤ 35 Rem	✗ 38.449 Rem (due to scope growth)
Reliability	Power Ascension ≤ 5 days	● 3 days, 21 hours, 21 minutes
	Reliability ≥ 90 days max capable power	✗ Mode 5 outage to replace 8010B



1R24 Review

Completed Primary Scope

- Including valve maintenance and containment fan cooler unit motor overhauls

Completed Secondary Scope

- Including high pressure main turbine inspection and valve maintenance

Completed Electrical Scope

- Including vital bus 4kV and 480v bus maintenance

Completed License Renewal Activities

- Including refueling water storage tank inspection

Completed Projects

- Including intake travelling screen frame replacements

1X25 Performance

- 1X25 was a planned Mode 5 outage to replace the Pressurizer Safety Valve 8010B in December of 2023.

Category	1X25 Goals	1X25 Performance
Safety	Zero Recordable Injuries	 Zero Recordable Injuries
	Zero Nuclear Safety Events	 Zero Nuclear Safety Events
	Zero SIF Actuals/Zero SIF Potentials	 Zero SIF Actuals/Zero SIF Potentials
Human Performance	Zero HU Event Site Clock Reset	 Zero HU Event Site Clock Reset
	Zero FME Events	 Zero FME Events
Outage Duration	≤ 8 Days 12 hours	 7 Days 23 hours 55 minutes
Dose Goal	≤ 848 mRem	 617 mRem
Reliability	Power Ascension ≤ 23 hours	 18 hours 28 minutes
	Reliability ≥ 90 days max capable power	 Final assessment in March 2024

Summary

- Diablo Canyon Unit 2 twenty fourth refueling outage (2R24) will take place during the Spring of 2024
- The 50-day planned outage will be very similar to 1R24 and encompass scope from license renewal required inspections, planned maintenance, and other refueling activities
- Approximately 1,000 temporary additional workers will support the safe completion of 2R24



2R24 Outage Goals

Category	Goal
Safety	Zero Recordable Injuries Zero Nuclear Safety Events – No loss of decay heat removal Zero SIF Actuals / Zero SIF Potentials
Human Performance	Zero HU Event Site Clock Resets Zero FME Events
Outage Duration	≤ 50 Days
Dose Goal	As Low As Reasonably Achievable ≤ 29.518 Rem
Reliability	Power Ascension ≤ 5 days Reliability ≥ 90 days max capable power



2R24 Scope

Primary

- Including large motor overhauls

Secondary

- Including valve inspections and maintenance

Electrical

- Including 4kV/480V Bus G maintenance

License Renewal

- Including refueling water storage tank inspection

Projects

- Including traveling screen frame replacements

Thank you

Erik Werner



DCPP Regulatory Performance Update

Jordan Tyman
Director, Risk and Compliance
February 22, 2024

September 2023 – February 2024

- DCPP continues to provide safe, clean, and reliable electricity to Californians
- Since the last update to the DCISC, the NRC oversight of DCPP included approximately ~2000 hours of inspection time
- All violations received since the last DCISC update were of very low safety significance
- DCPP remains in the highest performance category for all NRC Performance Indicators

DCPP remains in the highest performance category

- In addition to performing inspections, the NRC also evaluates every nuclear plant using performance indicators
- NRC gauges licensee performance using 16 separate indicators related to various aspects of plant operation
- DCPP remained in the highest performance category of the NRC's Reactor Oversight Process Action Matrix
 - Inspection findings very low safety significance (i.e., Green)
 - Performance indicators within the expected range (i.e., Green)

September 2023 – February 2024

NRC Violations

- All violations received since the last DCISC update were of very low safety significance
- Violation themes include:
 - Procedure use adherence
 - Opportunities to have more level of detail in procedures
 - Enhance compliance controls

Late September 2023 – February 2024

Licensee Event Reports

- Licensee Event Report (LER) has been submitted since the last DCISC meeting.
 - LER 2023-001-00, submitted 11/27/2023
 - Unit 1 reactor shut down in accordance with plant procedures, during a preplanned outage at approximately 11 percent power, due to increasing water level in a non-safety related feedwater heater



Upcoming Inspections

Upcoming NRC Inspections and License Renewal Inspections

- **Cyber Security Inspection – on-site inspection activities recently completed in early February**
- **2R24 Inservice Inspection – April 2024**
- **2R24 Radiation Protection Inspection – April 2024**
- **License Renewal Inspection – April 2024**

Recent License Amendments

- **Unit 2 License Amendment 246, issued 12/7/23 – Revision to Technical Specification 3.7.8, “Auxiliary Saltwater System,” allowed on a one-time basis an additional 72 hours for replacement of the ASW Pump 2-2 motor.**

License Amendment Requests

- **Risk-Informed Technical Specification Completion Times – submitted July 2023, supplement submitted January 2024**
- **10 CFR 50.69, Risk-informed categorization of structures, systems, and components – submitted September 2023**
- **Revision to TS 5.6.6 Pressure and Temperature Limits Report, to include additional NRC-approved calculation methodologies – Late February submittal**



DCPP Regulatory Performance Summary

Late September 2023 – February 2024

- DCPP remains in the highest NRC regulatory performance category
- All violations received since the last DCISC update were of very low safety significance
- DCPP continues to provide safe, clean, and reliable electricity to Californians

Thank you

Jordan Tyman
Director, Risk and Compliance



Nuclear Generation: Our 2024 Roadmap to Generating Excellence

Diablo Canyon Power Plant

Blair Jones

Director – Strategy, Policy, Organizational Effectiveness, &
Engagement

February 22, 2024



2023 Operating Plan Results

Nuclear Generation: Looking Back at 2023

- Transitioned organization to continued operations
- 200+ new coworkers
- Completed the 1R24 refueling outage safely with no nuclear safety or human performance challenges
- Third year in a row 100% availability during summer peak-period
- Submitted license renewal application ahead of schedule; obtained NRC “Sufficiency” determination
- Diablo Canyon remains in the highest performance category for all Nuclear Regulatory Commission (NRC) Performance Indicators

2023 Operating Plan Results

Measurable Results

Metric	Goal	Actual
DCPP Reliability & Safety Indicator	≥ 97.5	100.0
Days Away, Restricted, or Transferred Cases	1 st quartile	1 st quartile
Lost Work-Day Cases	1 st quartile	1 st quartile
Regulatory Findings	No significant	No significant
NRC Reactor Oversight Process	Column 1 and no cross-cutting issues	Column 1 and no cross-cutting issues



Our 2024 Roadmap

Our 2024 Roadmap to Generating Excellence aligns PG&E's Virtues, Purpose, and Stands to our work

Why We Exist (Purpose)

- Delivering for our hometowns
- Serving our planet
- Leading with love

Who We Are (Virtues)

- Trustworthy
- Empathetic
- Curious
- Tenacious
- Nimble
- Owners

What We Will Deliver (Stands)

- People
- Planet
- Prosperity



Our 2024 Roadmap

Our Mission is to safely generate clean, reliable, and affordable energy for California's hometowns

WE EARN THE RIGHT TO CONTINUE OPERATING EACH DAY

We hold ourselves and each other accountable to our standards

We plan, prepare, and execute our work correctly the first time

We pursue continuous improvement with rigor

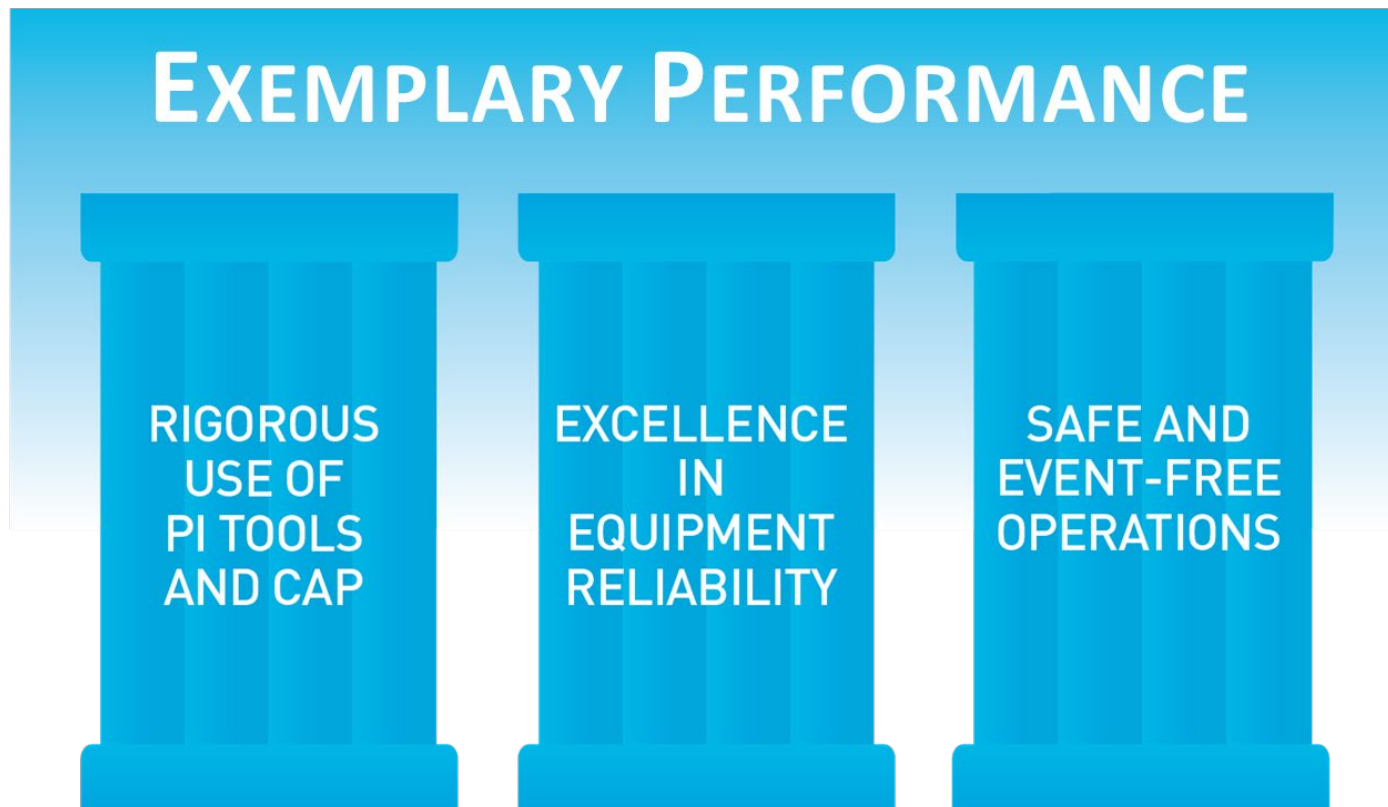
We work together to achieve excellence

We look out and care for one another

Our 2024 Roadmap

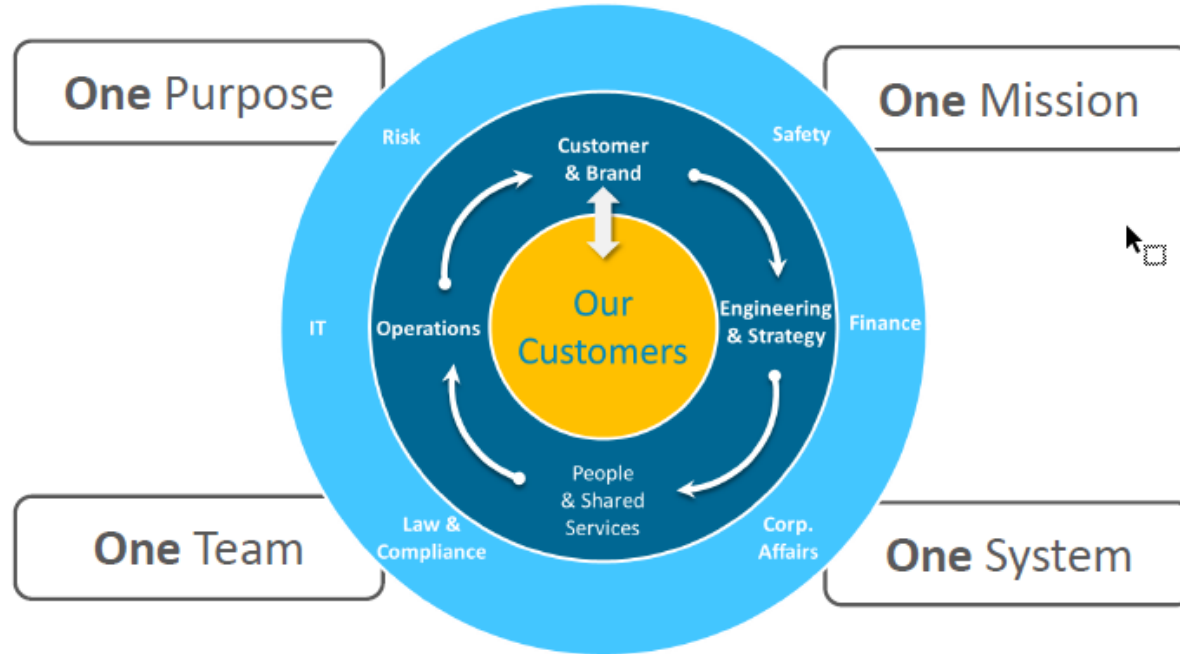
Our Pillars

Our Pillars ensure sustained exemplary performance in Generating Excellence



Our 2024 Roadmap

Lean Operating System



Our 2024 Roadmap

2024 Key Work Projects and Initiatives

- Maintain 1st quartile safety performance
- Execute all 2024 PG&E controlled requirements of SB846
- Safe execution of Unit 2 refueling outage (2R24) with license renewal inspections
- Prepare and execute a plan in support of peak summer reliability season
- Investing in our people

DCPP's Current Retention Program

- Under the current retention program, Diablo Canyon Power Plant (DCPP) employees were offered a 25% retention payment each year for seven years, through a two-tier program:
 - Tier 1 period (4 years, 2016-2020)
 - Tier 2 period (3 years, 2021-2023)
- Tier 1 finished with a 98% participation rate and Tier 2 exceeded 95% participation
- The Tier 2 retention period concluded on August 31, 2023

Retention through Continued Operations

- In 2022, California Senate Bill (SB) 846 was signed into law
- SB 846 directed the continuation of a coworker retention program
- PG&E submitted an application on the future retention program to the CPUC for consideration in 2023
- Agreement distributed to coworkers (94% participation rate)

Thank you

Blair Jones

Director – Strategy, Policy, Organizational Effectiveness & Engagement

Diablo Canyon Power Plant (DCPP) License Renewal

Presented by

Philippe Soenen, Director, Strategic Initiatives

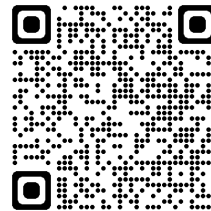
February 22, 2024



- Background
- License Renewal Organization
- Development of New License Renewal Application (LRA)
- Contents of LRA and Significant Changes
- LRA Activities 2023-2024

- In 2022, the State of California (State) asked PG&E to preserve the option of extending operations and take the necessary steps to relicense the plant for an additional 5 years.
- In response to the request from the State, PG&E submitted a license renewal (LR) application on November 7, 2023 to the NRC to help ensure electrical reliability statewide.

[DCPP's LRA submittal](#)



Development of the New LRA

- **New DCPP LRA**
 - Developed in accordance with latest NRC guidance on initial LR: NUREG-1801, Generic Aging Lessons Learned (GALL), Revision 2
- **Scoping and screening results from previous application**
 - Used as baseline and updated based on a review of plant changes (UFSAR, Correspondence, Design Changes, etc.)
- **Aging Management Programs (AMPs)**
 - Created new AMP Basis Documents
 - Current NRC guidance
 - Expedited AMP packages
 - Previous NRC LR requests for additional information and safety evaluation report
 - Recent Precedent
 - Operating Experience (OE) Review (Jan. 2013 - Feb. 2023)
 - Consistent with recent precedent, LRA has a commitment for each AMP

Contents of LRA and Significant Changes

- **Chapter 1, Administrative Information**
 - No significant changes
- **Chapter 2, Scoping and Screening Methodology**
 - Significant changes (transition to NFPA 805 and Alternate Source Term)
- **Chapter 3, Aging Management Review (AMR) Results**
 - Updated to incorporate latest NRC guidance
- **Chapter 4, Time-Limited Aging Analyses (TLAAs)**
 - Updates to address the NSSS Structural and Licensing Review project.
 - Updates to address the full structural weld overlays installed in Units 1 and 2 in 2019 and 2018, respectively.
 - Updates to address an analysis for the Unit 2 Charging Pump Discharge Line Welds WIC-45A and RB-46-7

Contents of LRA and Significant Changes

- **Appendix A, Final Safety Analysis Report Supplement**
 - Updated to incorporate latest NRC guidance for level of detail to eventually be included in the Updated Final Safety Analysis Report (UFSAR)
- **Appendix B, AMPs**
 - Majority of changes to AMPs were associated with updates to incorporate latest NRC and industry guidance
 - New Aboveground Metallic Tanks AMP
 - Buried and Underground Piping and Tanks considered and Existing Program
 - New Periodic Inspections for Selective Leaching AMP
 - 4 commitments planned to be implemented by 12/01/2028



DCPP License Renewal Commitment Implementation



Nov 2024: Period of Timely Renewal Begins for Unit 1

2023

2024

2025

2026

2027

2028

2029

2030

57% LR commitments
implemented (total)

Recurring inspections continue

Additional 34% Unit 2-specific
commitments implemented (total)

Recurring inspections continue

Remaining 9% of commitments have
program implemented

Remaining 9% of commitments have associated
initial inspections/modifications completed

**Recurring inspections
continue**

NRC oversight and on-site presence; existing inspection/maintenance activities continue

First Unit 1
NRC LR
Inspection

First Unit 2
NRC LR
Inspection

Unit 1
PTR Begins
91% of Unit 1 and
Unit common
Commitments
Complete

Unit 2
PTR Begins
91% of Unit 2
Commitments
Complete

PTR: period of timely renewal
LR: License Renewal

Contents of LRA and Significant Changes

- Appendix C, Commodity Groups (*not used at DCPP*)
 - This appendix was not used in the previous application
- Appendix D, Technical Specification Changes (*not used at DCPP*)
 - This appendix was not used in the previous application
- Appendix E, Environmental Report (ER)
 - ER was updated since it has been greater than 5 years since previous ER
 - Environmental studies from Decommissioning Planning were timely and used for development of the ER
 - ER development used industry experience from recent LR applicants



LRA Activities 2023-2024

4Q2023

LRA Submitted
11/24

NRC Conducted LR
71013 Inspection
Unit 1, Phase I
10/23

NRC
Determined
LRA Sufficient
12/23

1Q2024

Environmental
Scoping
Meetings
02/24*

Environmental
Scoping Period
Ends
02/23/24*

Deadline for
Hearing
Requests
03/04/24*

NRC OE Audit
02/24

NRC S&S Audit
02/24

2Q2024

NRC LR 71013
Inspection
Unit 2, Phase I
04/24

NRC LR 71002
Inspection
06/24

NRC Onsite
Audit
06/24

3Q2024

NRC Breakout
Sessions
07/24

NRC LR 71013
Inspection
Unit 1, Phase II
08/24

4Q2024

NRC Issue Draft
SEIS 10/24

Public Meeting
Draft SEIS
10/24*

End Draft SEIS
Comment
Period 11/24*

Questions?

SB-846

Seismic Assessment

Summary of study and conclusions

Albert Kottke, Chris Madugo – PG&E Geosciences Jearl Strickland - Consultant





PG&E commitment to seismic safety

- The NRC included a condition to the operating license for DCCP to continue to study and evaluate seismic information and perform updated studies as necessary
- PG&E developed the Long-Term Seismic Program (LTSP) in 1985 to satisfy this license condition that includes:
 - Established a Geosciences Dept. staffed with experts to keep abreast of new geological, geophysical, seismological, and seismic engineering updates and Lessons learned
 - Operation of a strong motion accelerometer array and the Central Coast Seismic Network
- PG&E is continuing the commitment for the LTSP for the duration of an extended operating license

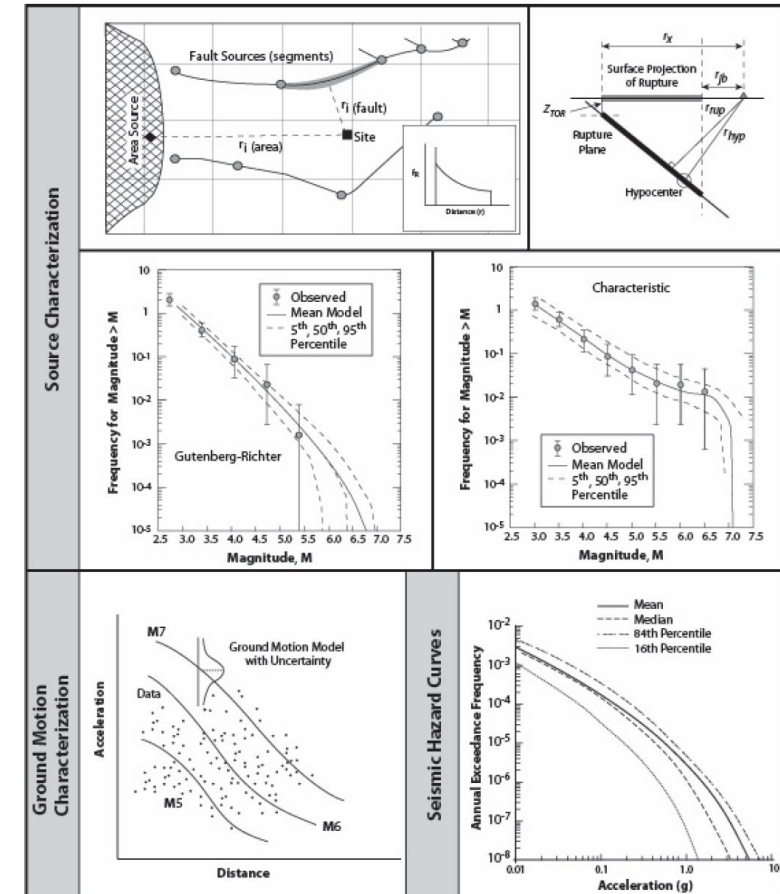
Key takeaways

- Senate Bill (SB) 846 updated seismic assessment completed in January 2024 with no significant findings
- The update found that continued research since 2015 identified minor changes in the source characterization of hazard-significant seismic sources but no significant increase in seismic risk
- The update found no new seismic information that would change the 2015 assessment conclusions that were reviewed and accepted by the Nuclear Regulatory Commission (NRC)
- The process and results were independently verified by that Participatory Peer Review Panel and a panel from UCLA Garrick Institute for the Risk Sciences

Seismic update process

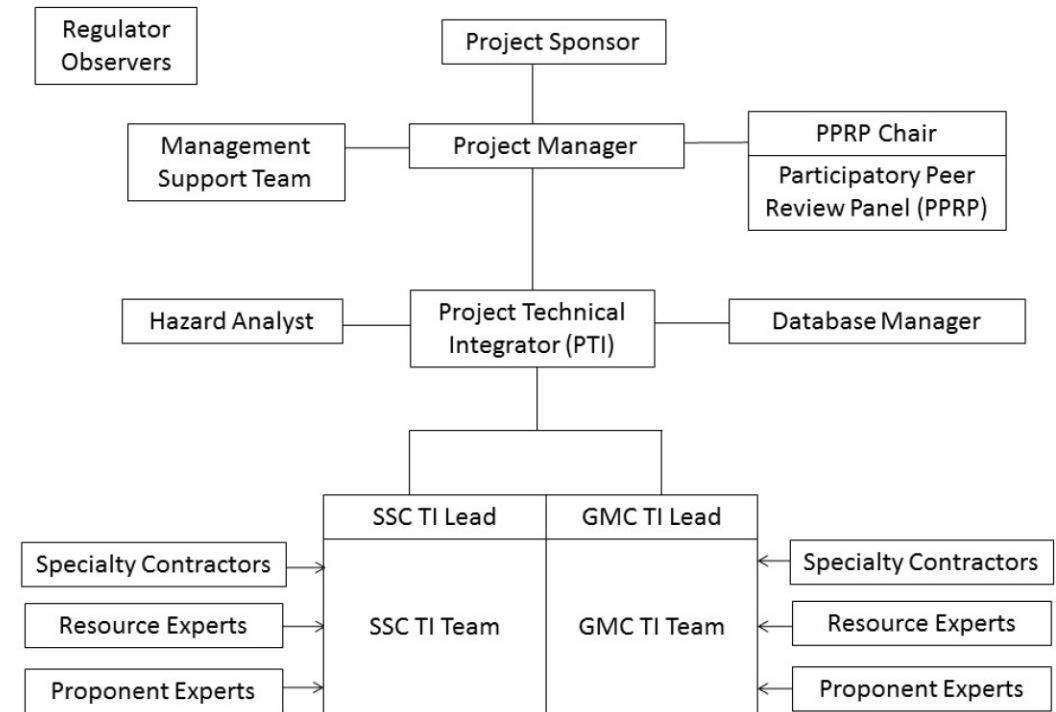
- Modeled after the NRC Senior Seismic Hazard Analysis Committee (or SSHAC) process, includes:
 - a two-step evaluation and integration process that is focused on capturing the center, body, and range of technically defensible interpretations
 - robust peer review and clear, transparent documentation
- Standard approach for conducting nuclear seismic hazard studies
- Modified to be incremental after evaluation stage

NUREG-2213 (2018) Updated Implementation Guidelines for SSHAC Hazard Studies



Roles within a SSHAC

- SSHAC process outlines specific roles and adhering to the roles is important for success of a project
- Technical Integration (TI):
 - At the center of the project
 - Gather inputs and develop the model
- Participatory Peer Review Panel (PPRP):
 - Subject matter experts engaged through the process
 - Primary reviewers



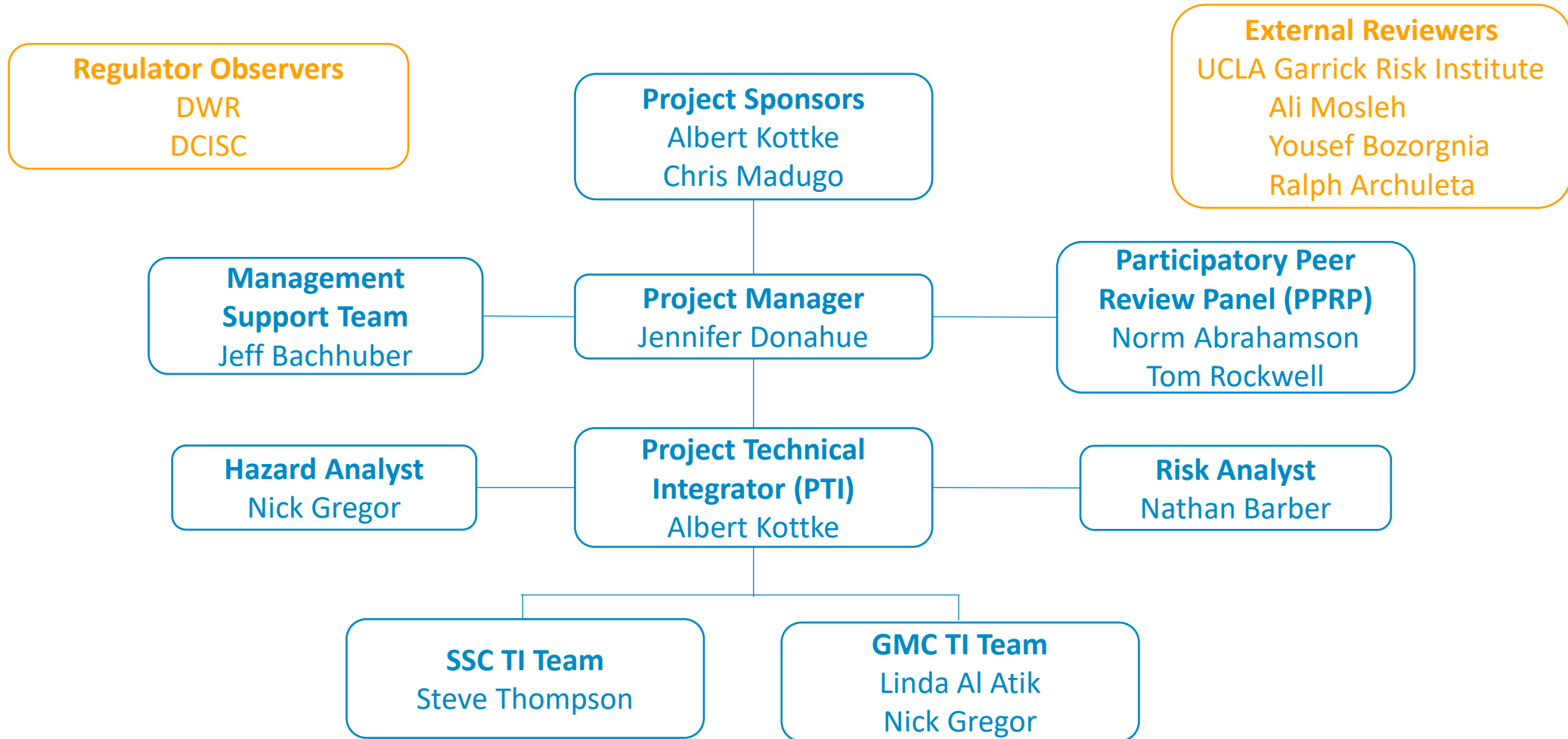
Roles within a SSHAC: Regulatory Observers

- Observers from DWR and DCISC were invited to attend all workshops
- Allows the regulatory bodies or other decision-makers to witness, first-hand, the process
- Questions and comments incorporated to improve project documentation





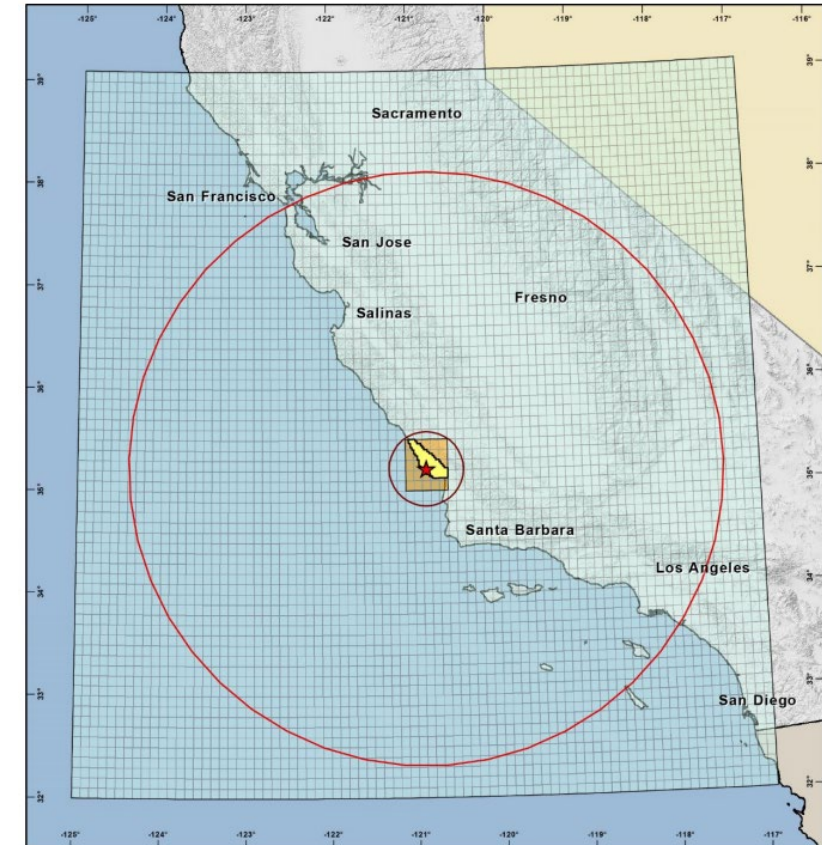
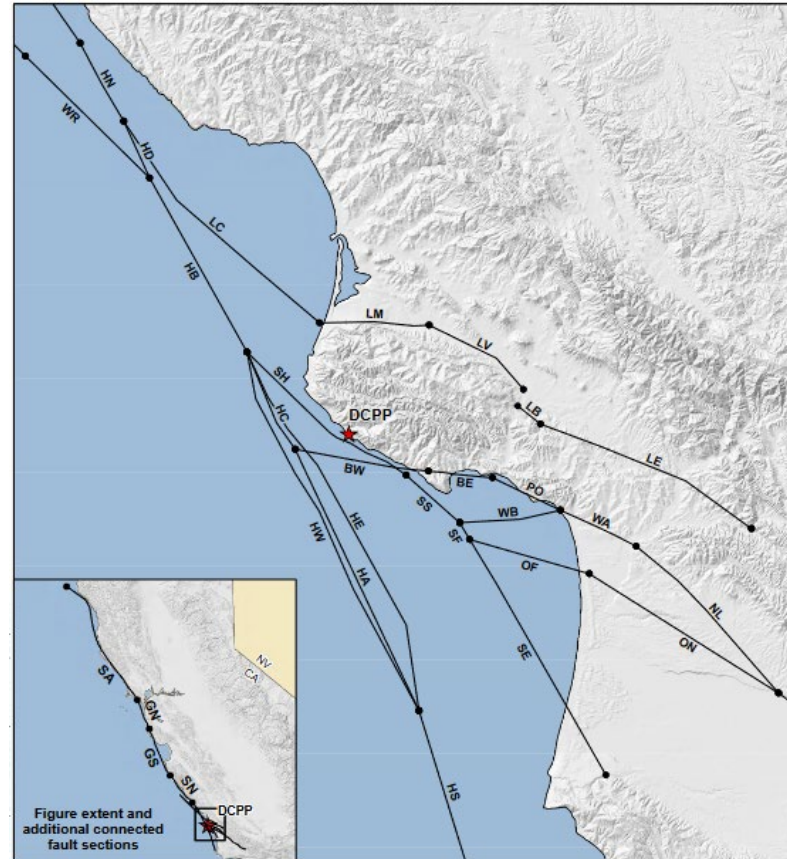
Project organization



Note: Specialty Contractors, Resource Experts, and Proponent Experts are not included on this project

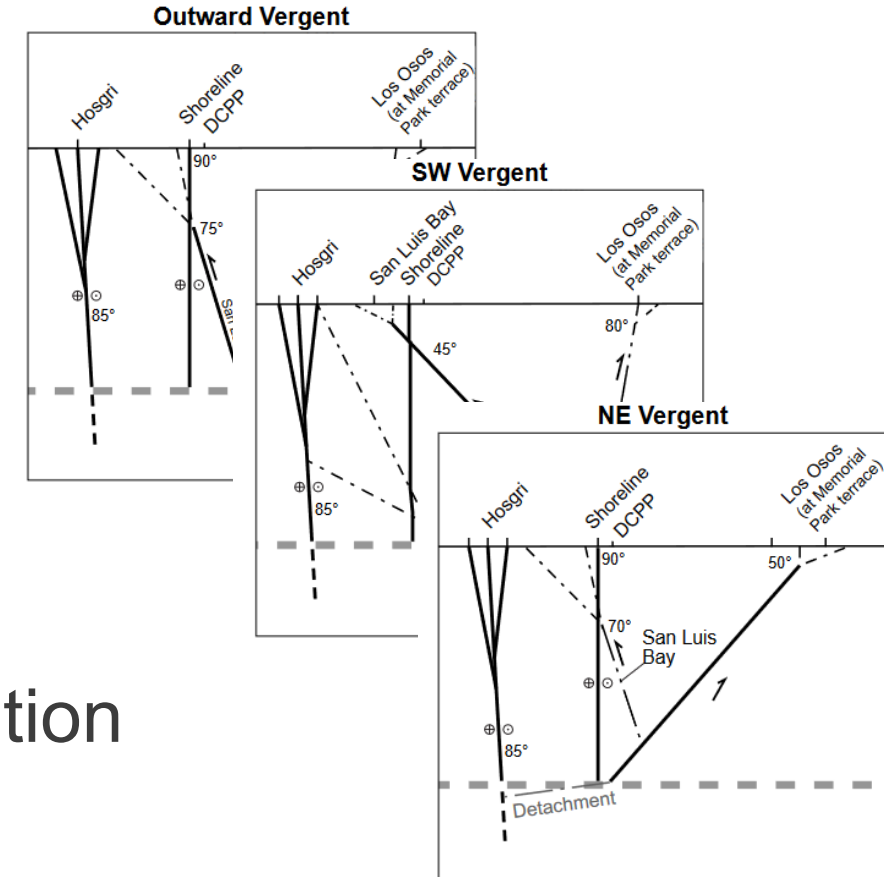
Seismic Source Characterization

- Primary fault sources:
 - Hosgri
 - Los Osos
 - San Luis Bay
 - Shoreline
 - Other faults
- Areal source zones:
 - Local source zone
 - Vicinity source zone
 - Regional source zone



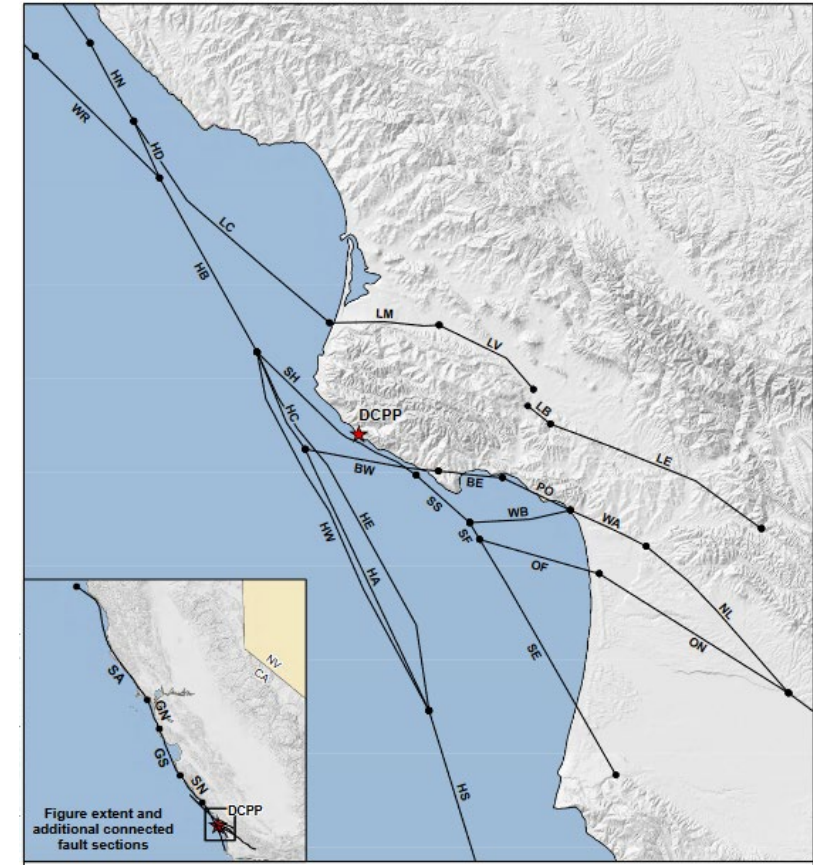
Fault source review process

- Fault-specific models:
 - Geometry
 - Slip rate
- General information review:
 - Rupture / slip rate allocation
 - Magnitude-recurrence distribution
 - Time dependency



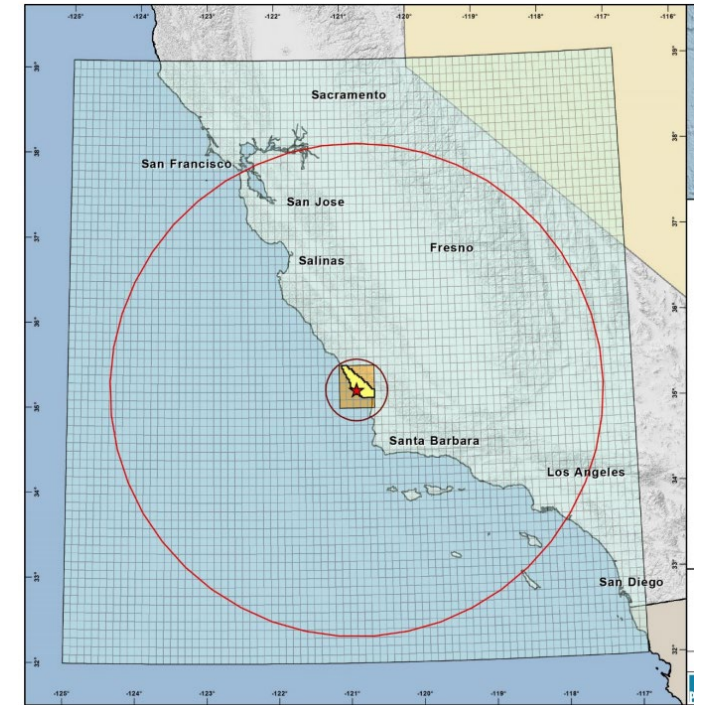
New information matrix: Fault-specific

Fault	Geometry	Slip Rate
Hosgri	No change	-Updated geologic rate, Pt. Estero (Cross-Hosgri slope)
Los Osos	No change	-Updated marine terrace uplift rate -New model for Irish Hills uplift rate
San Luis Bay	No change	-New model for Irish Hills uplift rate
Shoreline	No change	-Updated geologic rate, SLO Bay
All Faults	No change	-Updated regional deformation models



New information matrix: Source-zone specific

Source Zone	Geometry, kinematics	Recurrence Rate and b-Value
Local Area	No change	-Updated earthquake catalog
Vicinity	No change	-Updated earthquake catalog -Updated NSHM gridded seismicity rates
Regional	No change	-Updated NSHM gridded seismicity rates
All		-Updated regional deformation models



External contentions

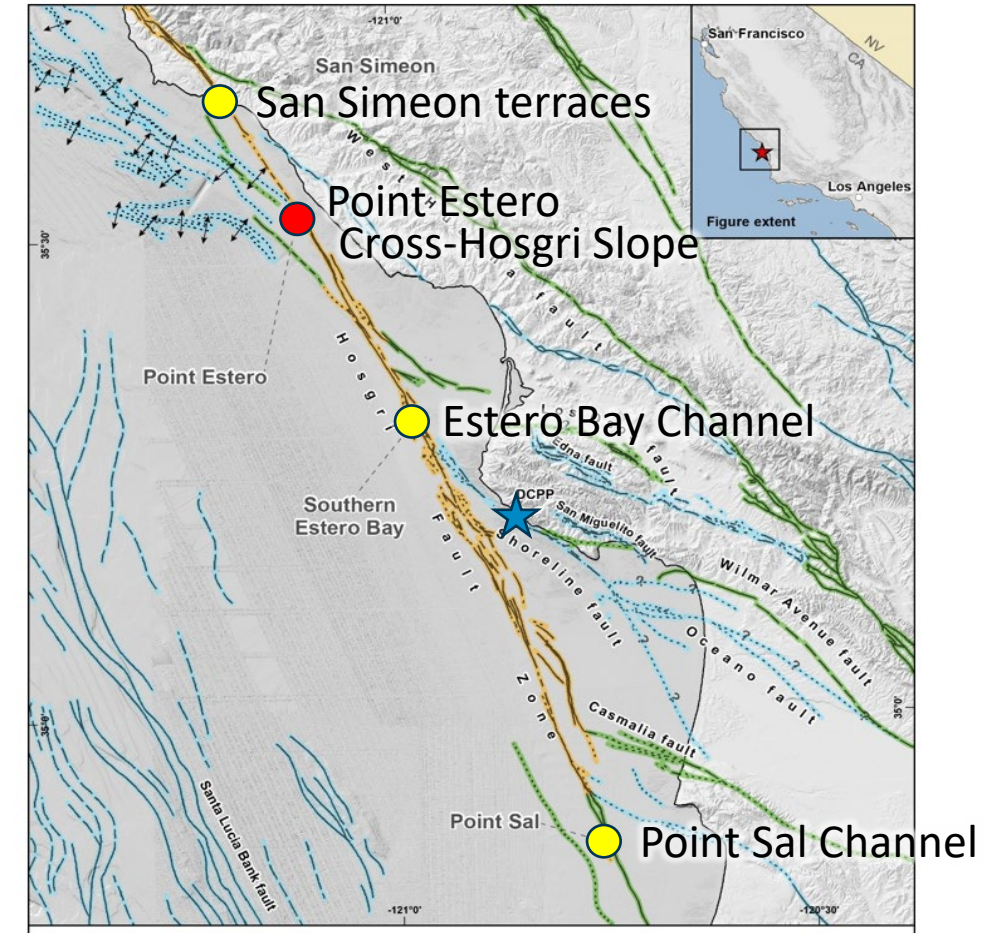
- External proponents questioned the following aspects of 2015 seismic source characterization model:
 - Use and incorporation of geodetic/kinematic models (e.g., NeoKinema)
 - Lack of inclusion of Seismic Hazard Inferred from Tectonics model
 - New proponent models of fault geometry and uplift rate of the Irish Hills
- The potential application of each these model elements were evaluated and considered in the 2023 assessment and are documented in the report

Hosgri slip rate characterization

- Slip rate estimation based on observed offset and age of geologic feature (distance per time)
- Model slip rate for the Hosgri based on four sites
- Since 2014 new CRADA sponsored studies on the Cross-Hosgri Slope by UCSB/USGS/others
- Increased confidence in offset and age of Cross-Hosgri Slope feature

Revised mean slip rate for Cross-Hosgri Slope Site

	2015	2023 Update
Mean	2.5	2.6



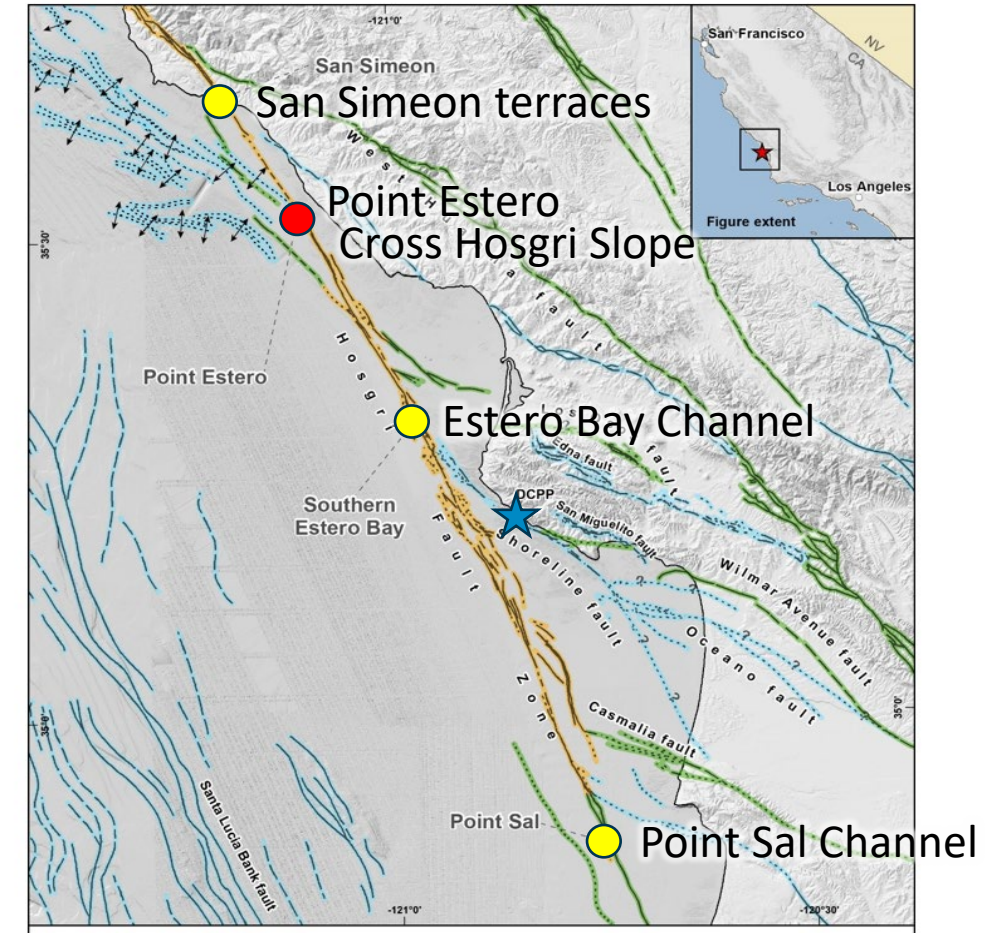
Updated weights for Hosgri slip rate sites

Much higher confidence in Cross-Hosgri Slope site

Site	2015 Weight	2023 Weight
San Simeon Terraces	0.3	0.25
Cross-Hosgri Slope	0.2	0.50
Estero Bay Channel	0.3	0.20
Point Sal Channel	0.2	0.05

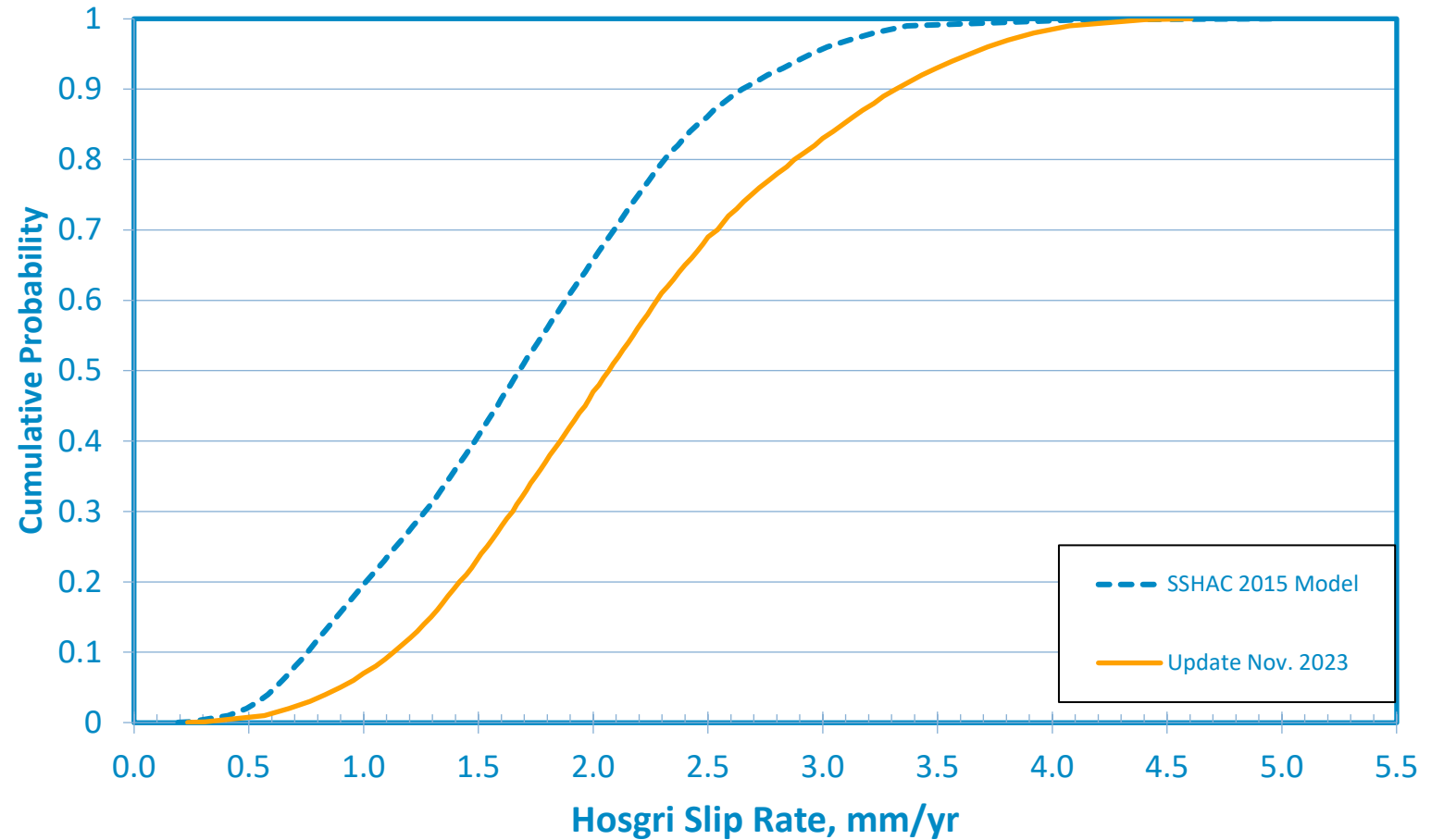
Weight factors for each site developed based on:

- Applicability of location
- Applicability of age
- Uncertainty in age
- Uncertainty in offset



Update Hosgri slip rate cumulative density function (CDF)

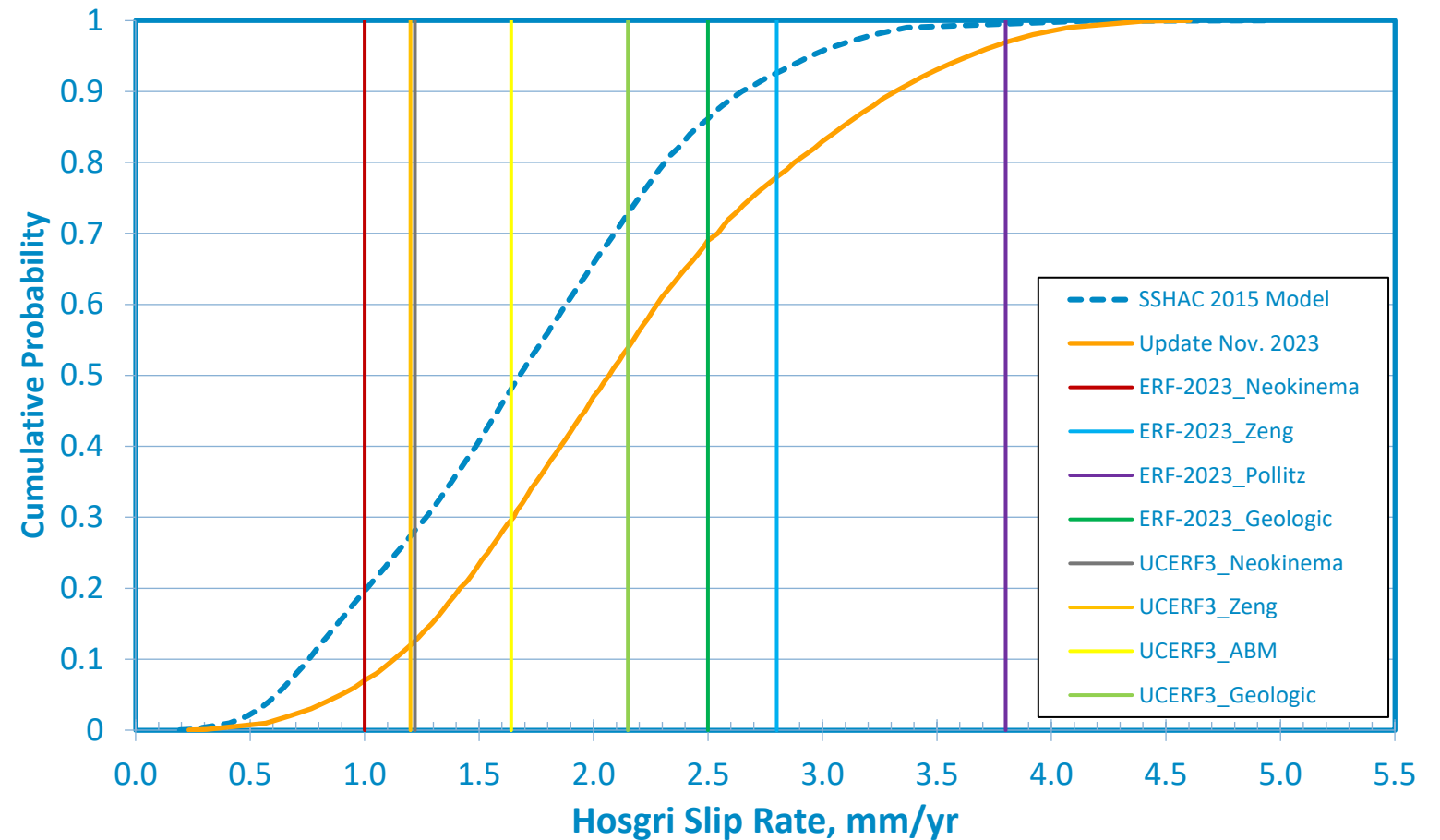
Percentile	Slip Rate (mm/yr)		
	2015	2023	Change
Mean	1.70	2.14	26%
5 th	0.62	0.90	46%
50 th	1.68	2.07	23%
95 th	2.95	3.64	23%





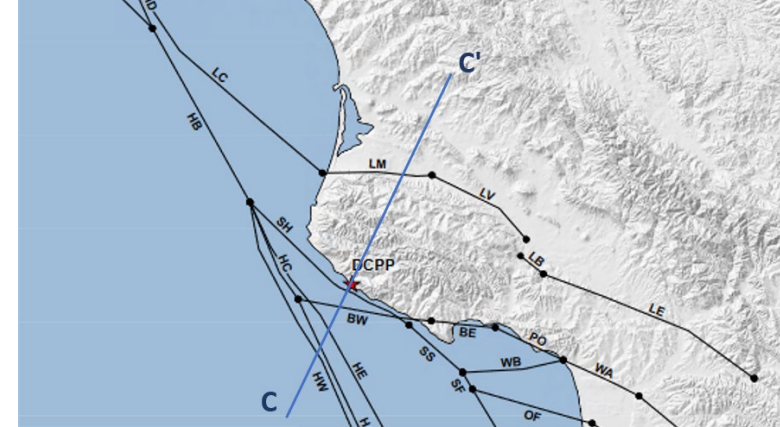
Hosgri slip rate CDFs compared to UCERF 3/2023 regional deformation models

Percentile	Slip Rate (mm/yr)		
	2015	2023	Change
Mean	1.70	2.14	26%
5 th	0.62	0.90	46%
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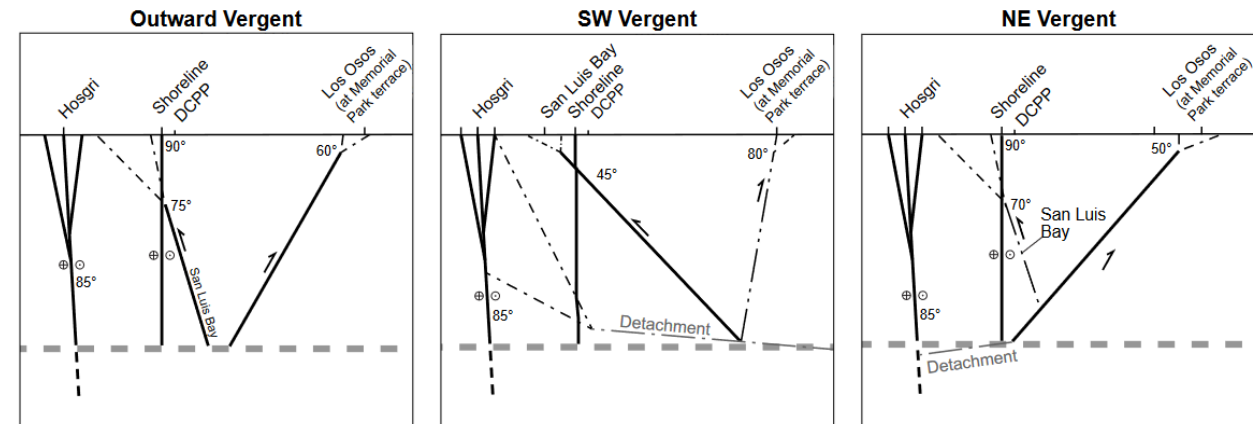


Los Osos fault slip rate

- Slip rate based on uplift rate of Irish Hills determined from uplifted marine terraces
- New study indicates that sea level was higher when key terraces formed
- Less uplift required to achieve present elevation
- Results in lower uplift rate

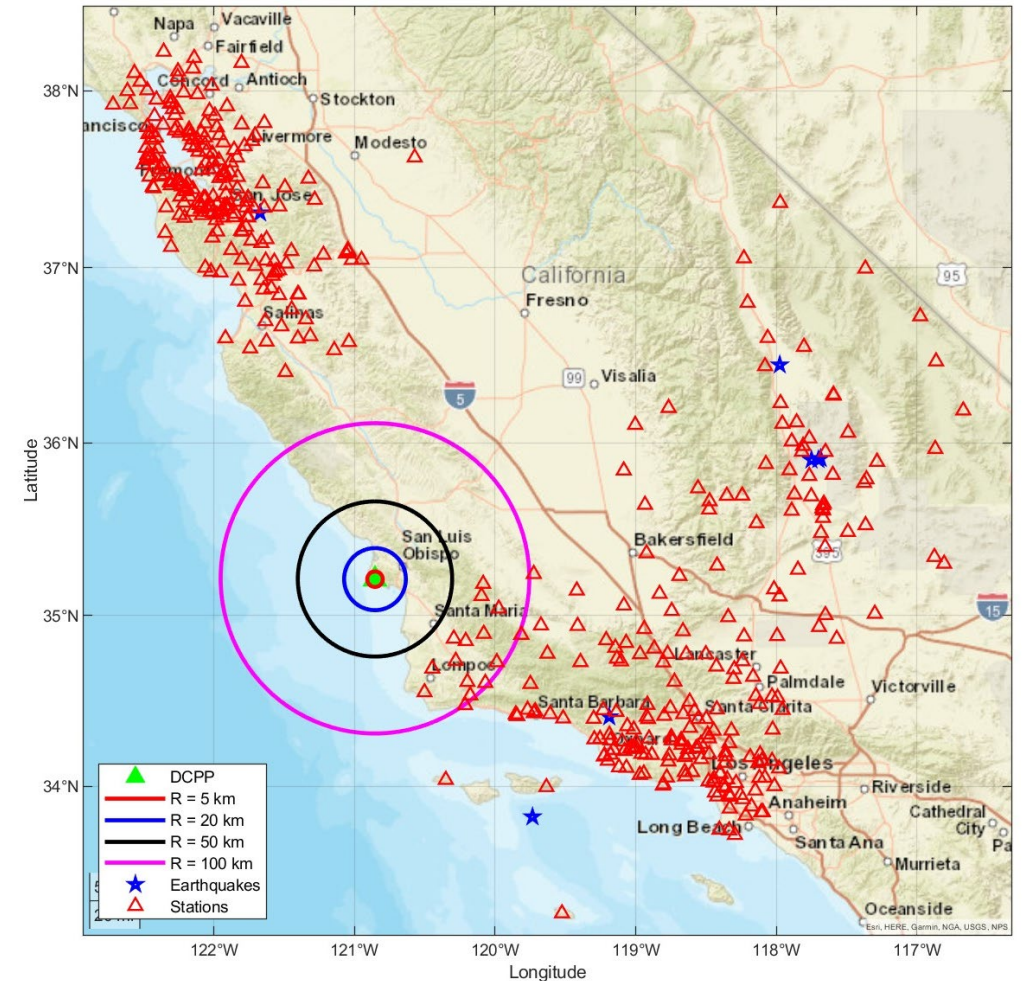


Slip Rate (mm/yr)			
OV Model	2015	2023	Change
Mean	0.26	0.22	-15%
SW Model	2015	2023	Change
Mean	0.19	0.17	-15%
NE Model	2015	2023	Change
Mean	0.42	0.39	-9%



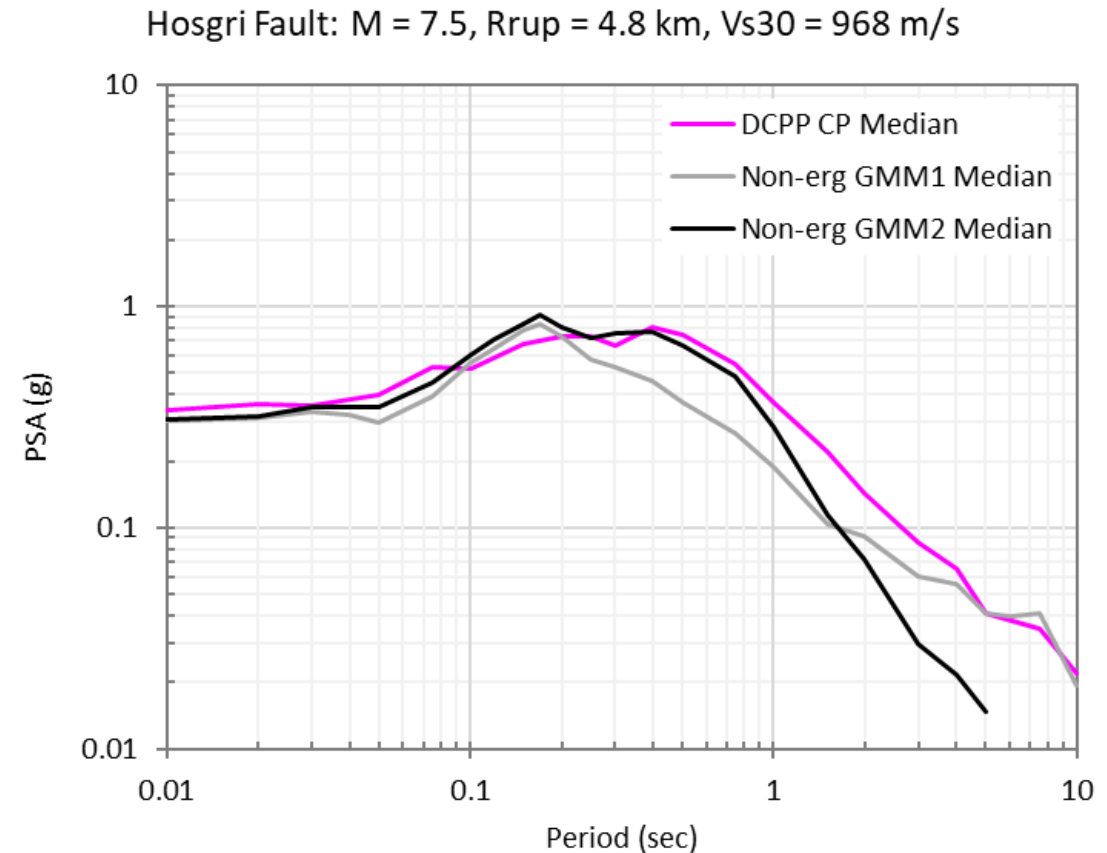
Comparison of median model to new data

- Catalogs:
 - NGA-West3: **M5.09**, **M6.02**, **M7.06**
 - Turkey: **M7.8**
 - DCCP: **M5.1** and **M5.1**
- Comparison summary:
 - No apparent trend in magnitude or R_{rup} distance
 - Zero or negative residuals; 2015 ground motions greater than limited new empirical ground motion recordings
- No updates are recommended



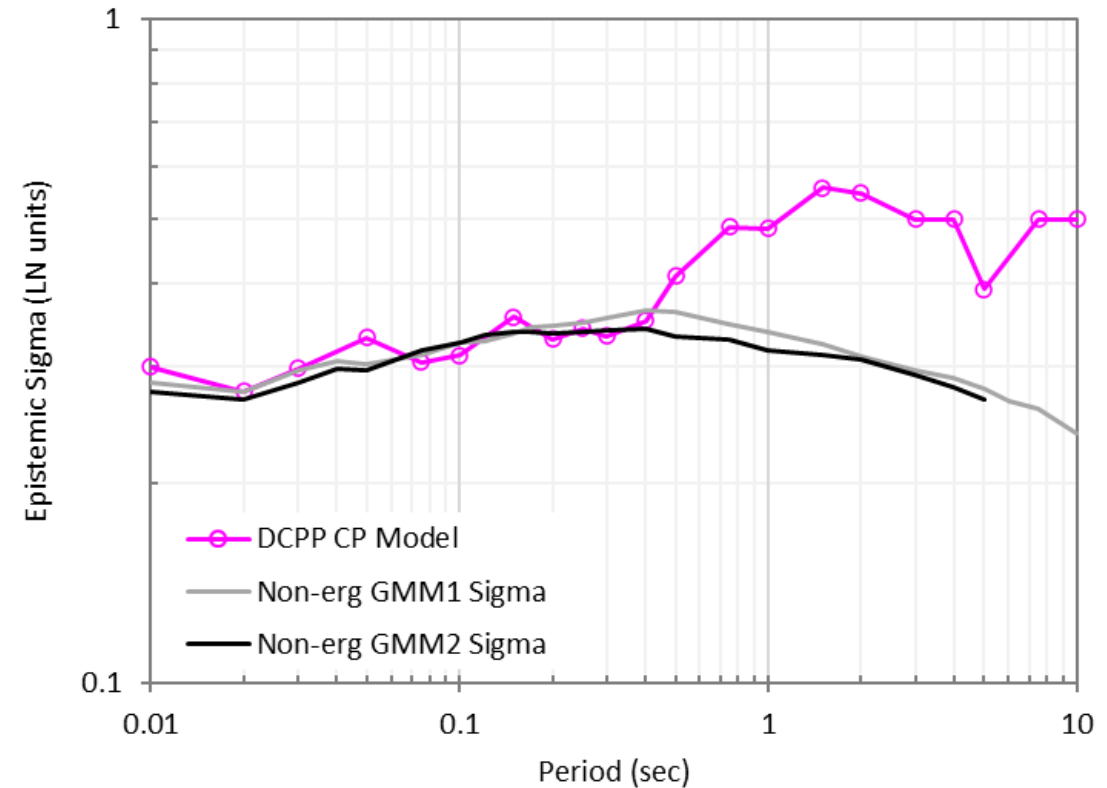
Comparison of DCP model with LA23

- Nonergodic models represent the primary thrust of ground-motion research
- Lavrentiadis and Abrahamson (2023) [LA23] developed non-ergodic spectral acceleration ground-motion models for California
- Compare the SWUS DCP and LA23 models at the DCP control point
- Results:
 - $T < 0.3$ s: Good agreement between the 2015 DCP model and the LA23 non-ergodic models in terms of the median ground motion and its epistemic uncertainty
 - $T > 0.3$ s: The median ground motion and epistemic uncertainty predicted by the SWUS DCP model exceed those of the non-ergodic models
- No updates recommended



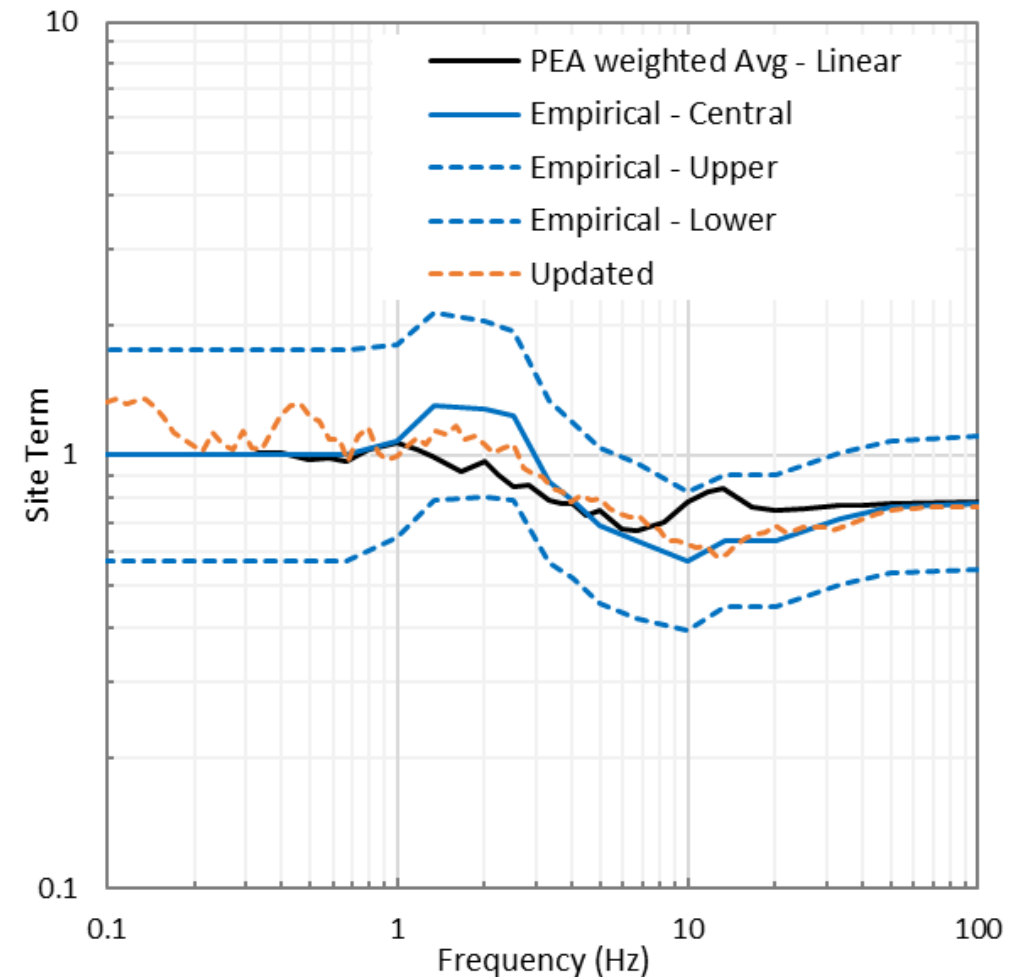
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- No updates recommended



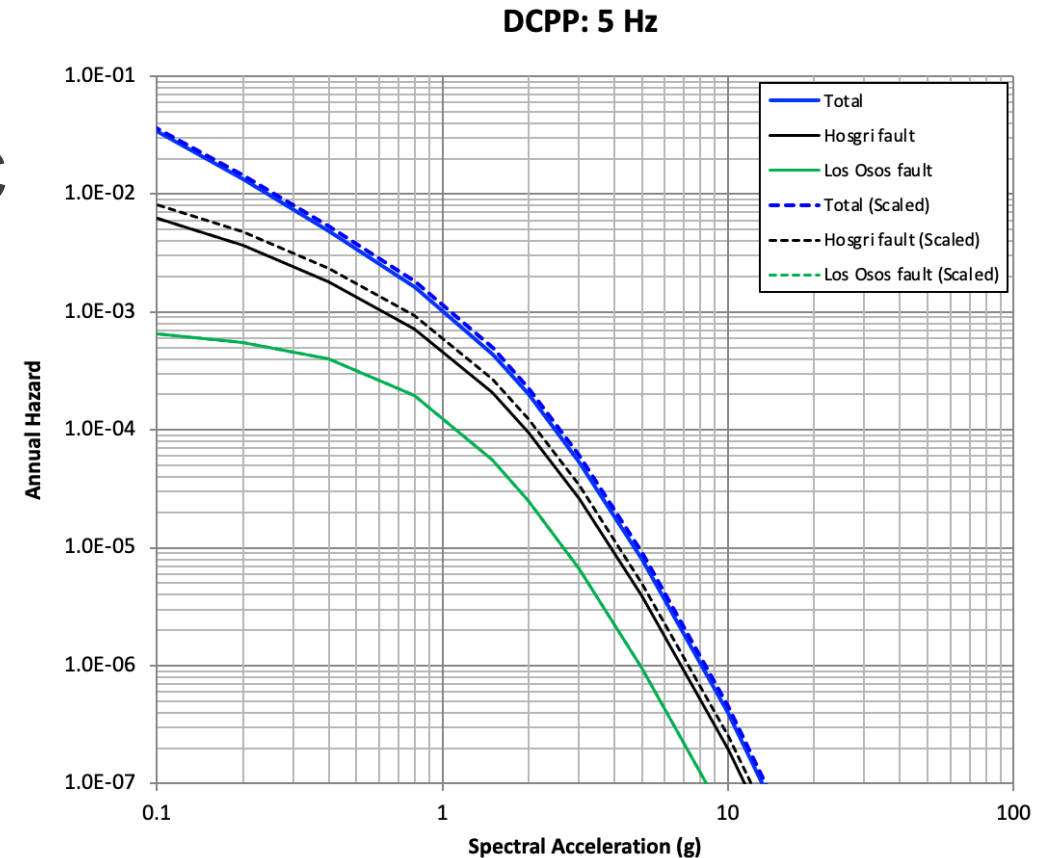
Evaluation of site characterization

- Analytical modeling used in 2015 is still state-of-the-practice
- Empirical modeling used in 2015 relied on limited recordings; but no additional data
- Applied non-ergodic modeling to preliminary dataset
 - Non-ergodic approach allows using spatial correlation to include regional data and extrapolate trends
 - General behavior is consistent with 2015 model; improves confidence in previous model
 - Not adopted due to preliminary nature of the dataset and approach
- No changes recommended

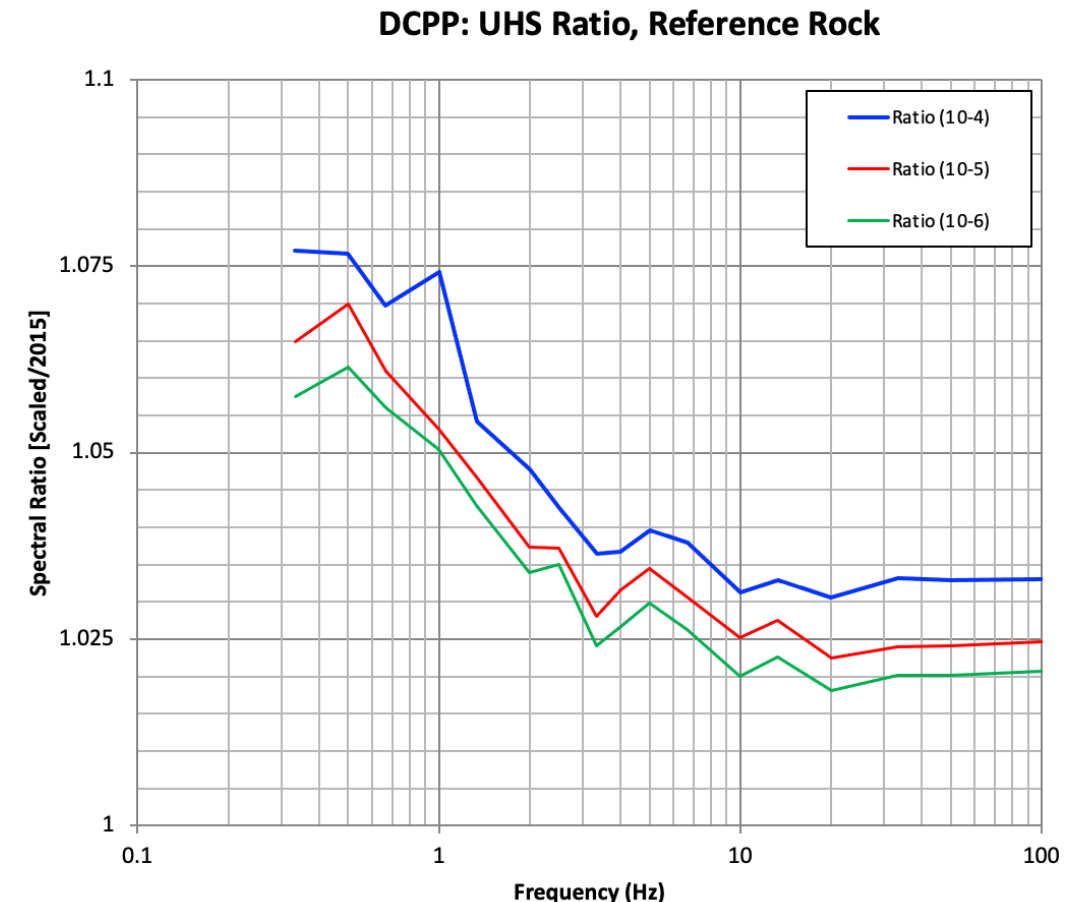
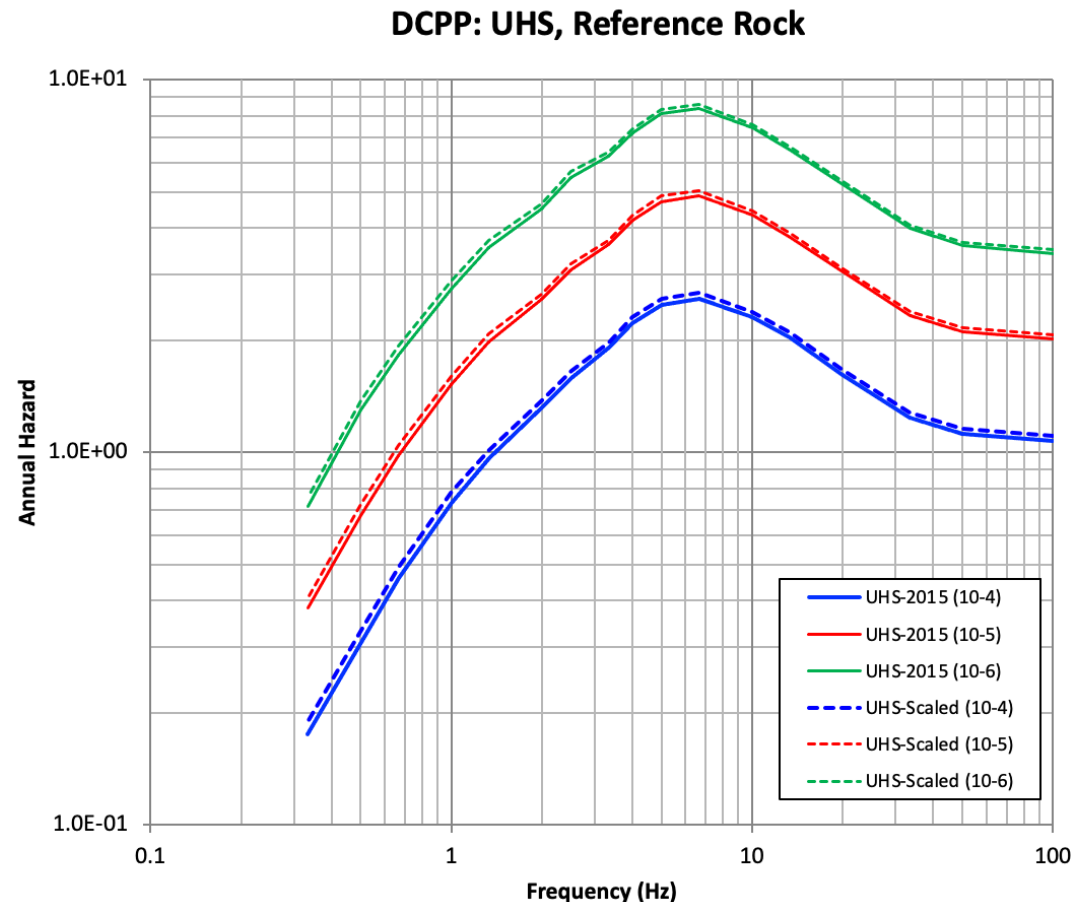


Hazard evaluation

- Evaluation of model found:
 - No changes warranted in GMC
 - Changes to slip-rate in SSC
- Changes to slip-rate:
 - Easily incorporated through scaling of hazard curves
 - Hazard recalculation not required



Changes in uniform hazard response spectra



- Frequency-dependence of the changes are due to varying contributions for the seismic sources
- Changes are less than the threshold of 10% used by the NRC Process for the Ongoing Assessment of Natural Hazard Information (POANHI)

Probabilistic risk assessment

- Risk model updated in August of 2023 (PG&E, 2023), includes:
 - Updates to equipment reliability data
 - Resolutions to industry peer-review comments
- Considered a conservative range of hazard scale factors
- Total core damage frequency (CDF) and large-early release frequency (LERF) remain below Region II risk criteria from Regulatory Guide 1.174 Revision 3; Total CDF and LERF are less than $1\text{E-}04/\text{yr}$ and $1\text{E-}05/\text{yr}$
- Systems, structures, and components (SSCs) fragility Fussell-Vesely and Risk Achievement Worth (RAW) importance were reviewed to confirm that the relative importance of SSCs did not change

Excerpts from closure letters

Participatory Peer Review Panel (PPRP):

“The PPRP agrees with the conclusion that the new information for the SSC and GMC that has been developed since the 2015 seismic hazard study does not significantly change the estimate of the seismic risk for DCPP.”

UCLA Garrick Risk Institute external peer review panel (EPRP):

...[the review team] provided multiple comments on the evaluation process and technical issues covered in the DCUSA draft report. These comments have all been considered by the TI team of the DCUSA and the report has been updated accordingly. The EPRP agrees with the findings of the study as documented in the final report.



Upcoming public release of report

- Documentation of 2023 seismic update will be published on PG&E seismic studies website after ADA compliance efforts are completed
- PG&E will provide an update to the DCISC when this is complete

Conclusions

- The update found that continued research since 2015 identified minor changes in the source characterization of hazard-significant seismic sources but no significant increase in seismic risk
- The update found no new seismic information that would change the 2015 assessment conclusions that were reviewed and accepted by the Nuclear Regulatory Commission (NRC)
- The process and results were independently verified by that Participatory Peer Review Panel and a panel from UCLA Garrick Institute for the Risk Sciences

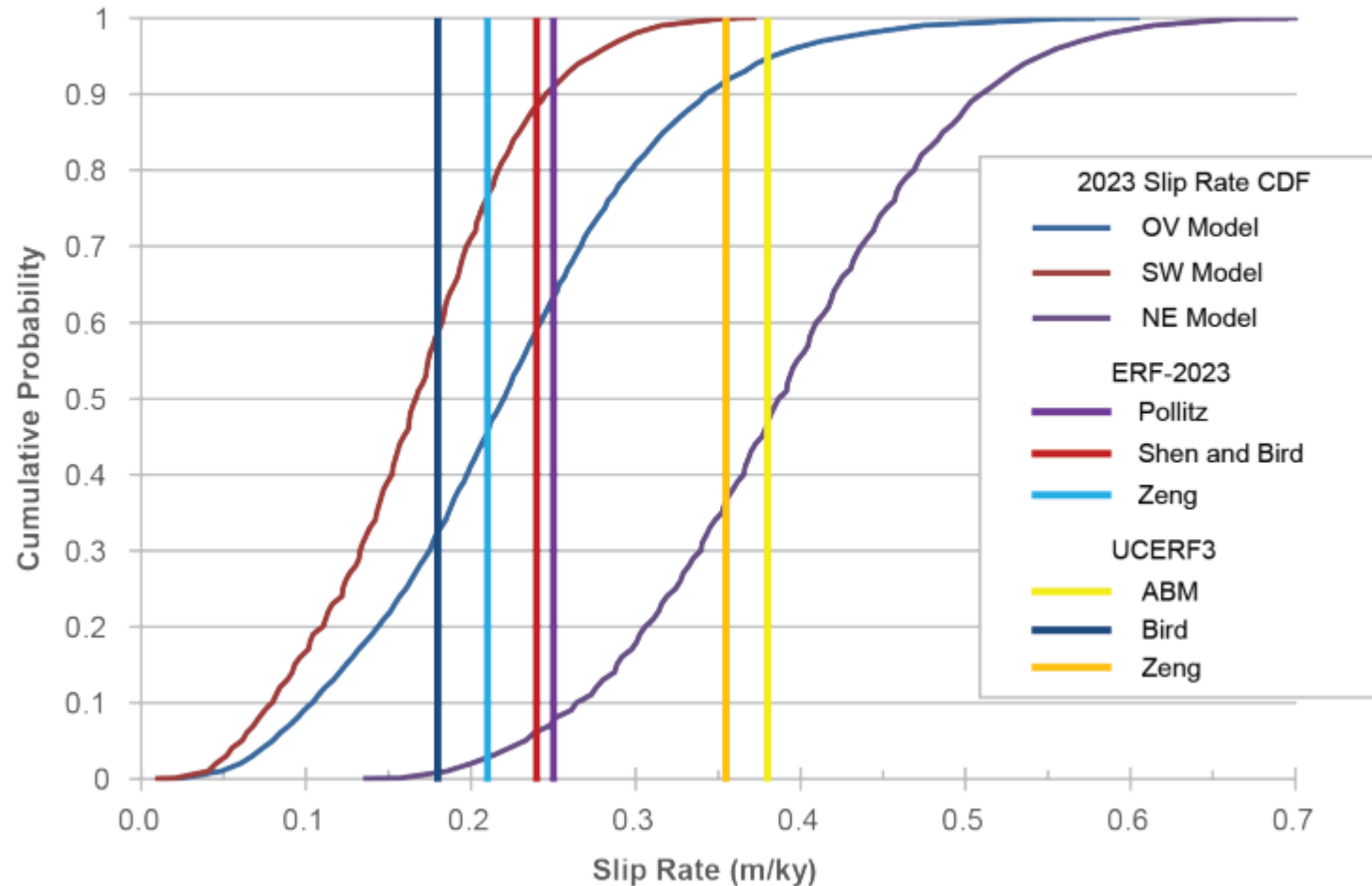
Questions?



Extra Technical Slides



Los Osos slip-rate CDFs compared to UCERF 3/2023 regional deformation models



Results of SB-846 Independent Review

Diablo Canyon Power Plant

Allen Wilson

Sr. Director, Engineering, Projects, & Outages

February 22, 2024



Diablo Canyon Power Plant Maintenance

- At Diablo Canyon Power Plant (DCPP) all necessary investments and maintenance to ensure safe and reliable operations has and continues to be performed.
- The Nuclear Regulatory Commission (NRC) continues to assess and reaffirm that Diablo Canyon is operating safely and is among the highest performing plants in the nation.
- Additionally, the Diablo Canyon Independent Safety Committee (DCISC) thoroughly evaluates maintenance activities at DCPP on a routine basis.

SB-846 Independent Consultant Review

- A provision of SB 846 required PG&E to commission a study by independent consultants to catalog and evaluate any deferred maintenance at DCPD and to provide recommendations as to any risk posed by the deferred maintenance, potential remedies, and cost estimates of those remedies, and a timeline for undertaking those remedies.
- To meet this requirement PG&E hired two independent industry experts – both with over 40 years of nuclear experience, one with vast regulatory experience and the other with extensive industry experience.

SB-846 Independent Review Results

The October 31, 2023, final report concluded:

- DCPD has not experienced any deferred maintenance that would create a vulnerability to future operation or warrant remediation actions;
- DCPD has been well-maintained, has a strong performance record, and that staff and management continue to be clearly focused on safe and reliable operation of the plant; and
- No deferred maintenance was identified; therefore, the Independent Review Team did not identify any potential remedies.

Other Independent Review Conclusions

- Other independent reviews had similar conclusions:
 - **DCISC:** “DCPP's process for reviewing the need for changes to Preventive Maintenance activities, Corrective Maintenance activities, and projects to support five years of extended operations (the PMO++ Program) appeared well planned and implemented.”
 - **NRC:** “...No maintenance plan was deferred that would impact plant safety or reliability and records were kept of the licensee's decision to make any changes...the licensee devised a comprehensive and systematic approach to evaluate what was needed to continue to operate the reactors safely...”

Independent Review Conclusions (cont'd)

- **STARS:** "...[O]bjective was to review the Project Results for the purpose of identifying potential gaps or opportunities in consideration of Risk, Project Timing / Prioritization and Organizational Ability to Execute...We concluded that your Team has a developed a coordinated plan for completion of these activities along with the appropriate priorities."
 - **INPO/Industry Executives:** "Overall, the approach is aligned to industry practice and no deficiencies were identified in the process and products reviewed."
- These reviews support our focus to maintain the plant to the highest standards and ensure we meet all regulations and requirements to support extended operations.

Thank you

Allen Wilson

Sr. Director, Engineering, Projects, & Outages

