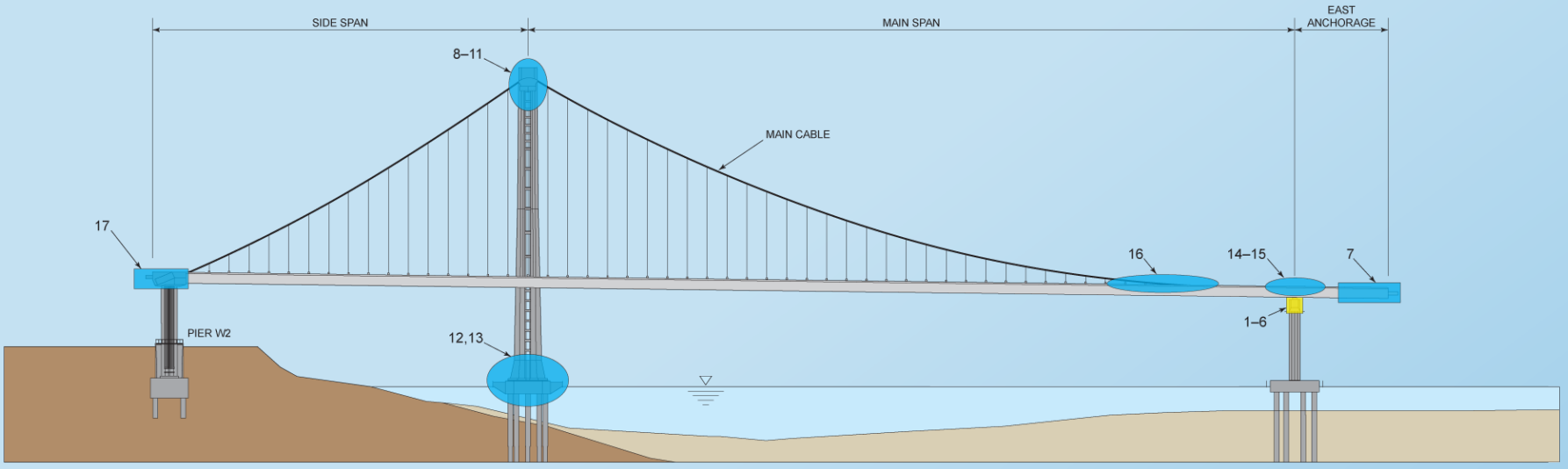
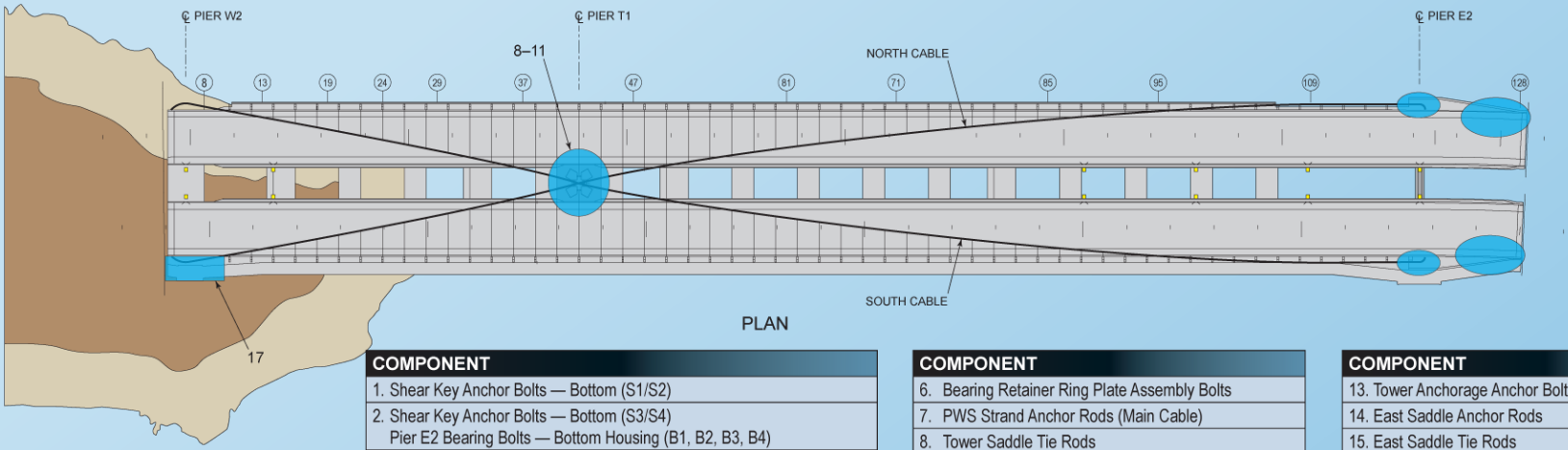
San Francisco-Oakland Bay Bridge East Span Replacement Project Update 9/10/2014

THE SAN FRANCISCO-OAKLAND
BAY BRIDGE
SEISMIC SAFETY PROJECTS
CALTRANS · BAY AREA TOLL AUTHORITY · CALIFORNIA TRANSPORTATION COMMISSION

ASTM A354 Grade BD Rods Across SFOBB-SAS



ELEVATION (LOOKING NORTH)



PLAN

COMPONENT
1. Shear Key Anchor Bolts — Bottom (S1/S2)
2. Shear Key Anchor Bolts — Bottom (S3/S4) Pier E2 Bearing Bolts — Bottom Housing (B1, B2, B3, B4)
3. Shear Key Anchor Bolts — Top (S1/S2) Shear Key Anchor Bolts — Top (S3/S4)
4. Pier E2 Bearing Bolts — Top Housing
5. Spherical Bearing Bushing Assembly Bolts

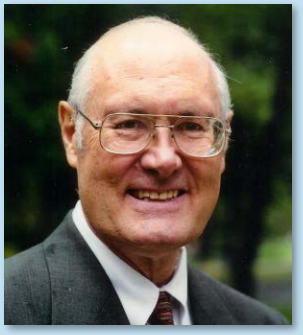
COMPONENT
6. Bearing Retainer Ring Plate Assembly Bolts
7. PWS Strand Anchor Rods (Main Cable)
8. Tower Saddle Tie Rods
9. Tower Saddle Turned Rods (@ Splices)
10. Tower Saddle Grillage Bolts
11. Tower Outrigger
12. Tower Anchorage Anchor Bolts (75 Dia. Anchor Bolts)

COMPONENT
13. Tower Anchorage Anchor Bolts (100 Dia. Anchor Bolts)
14. East Saddle Anchor Rods
15. East Saddle Tie Rods
16. Cable Bracket Anchor Rods
17. Bikepath Anchor Bolts at Pier W2

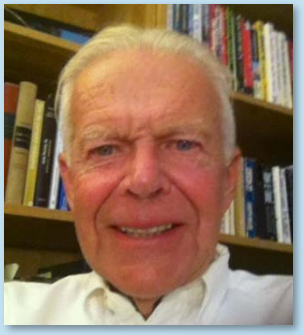
Testing Program Objective

- Further investigation of the fracture of the A354BD threaded rods.
- Evaluate if other A354BD threaded rods require modifications.

Fastener, Materials, & Corrosion Specialty Consultants



Alan Pense, Ph.D., NAE

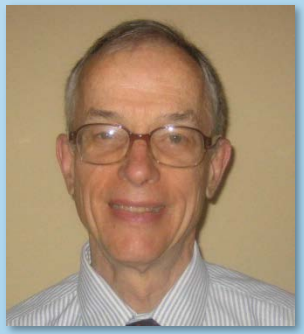


Herbert E. Townsend, Ph.D., P.E.

Louis Raymond, Ph.D., P.E.

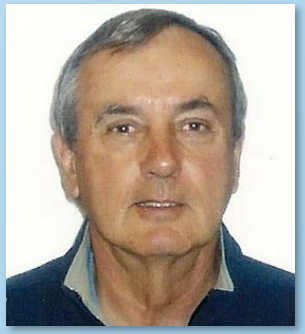
Douglas E. Williams, P.E.

Karl H. Frank, Ph.D., P.E.



Jeffrey Gorman, Ph.D., P.E.

Sheldon W. Dean Jr., Sc.D., P.E.



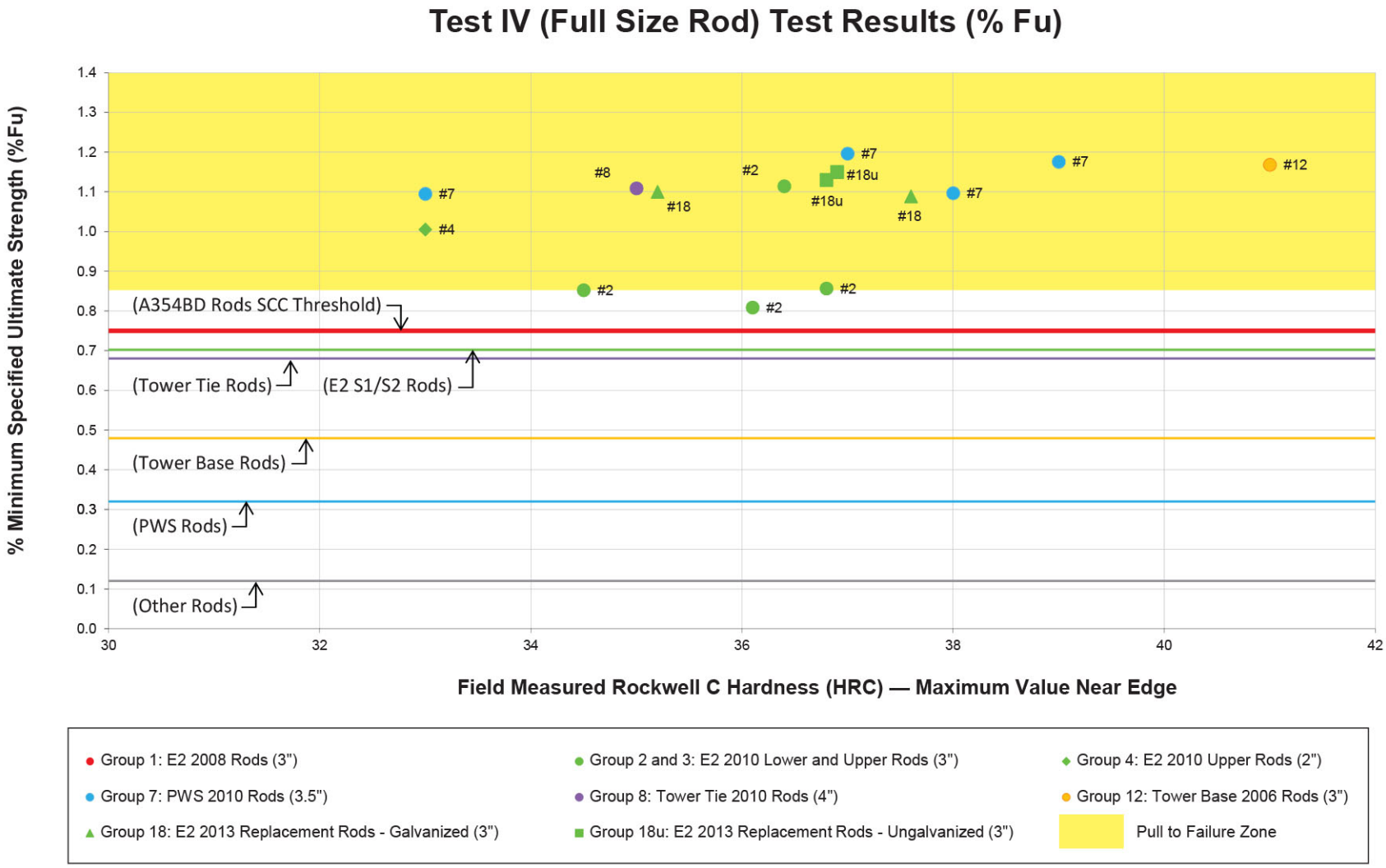
Robert Heidersbach, Ph.D., P.E.

Thomas Langill, Ph.D.

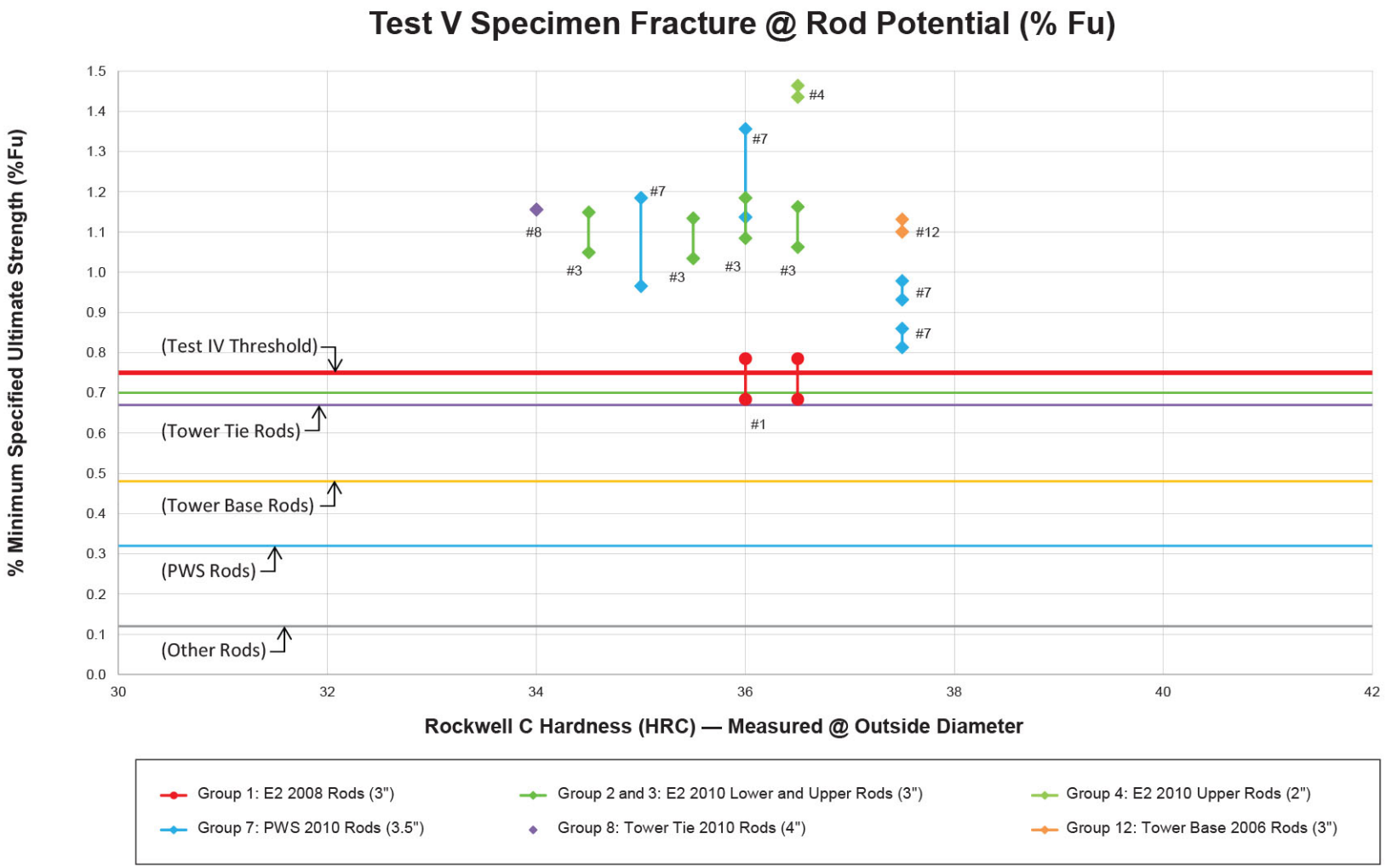
Typical Test I, II, and III Results

	2006 (Average)	2008 (Average)	2010 (Average)	2013 (Average)
Hardness — Lab (R/2) (HRC)	35	36	34	35
Hardness — Lab (Edge) (HRC)	34	38	35	36
Toughness - CVN (ft-lb)	35	14	37	48
Full Size Tensile (ksi)	159	161	153	162

Test IV — Townsend Test Results



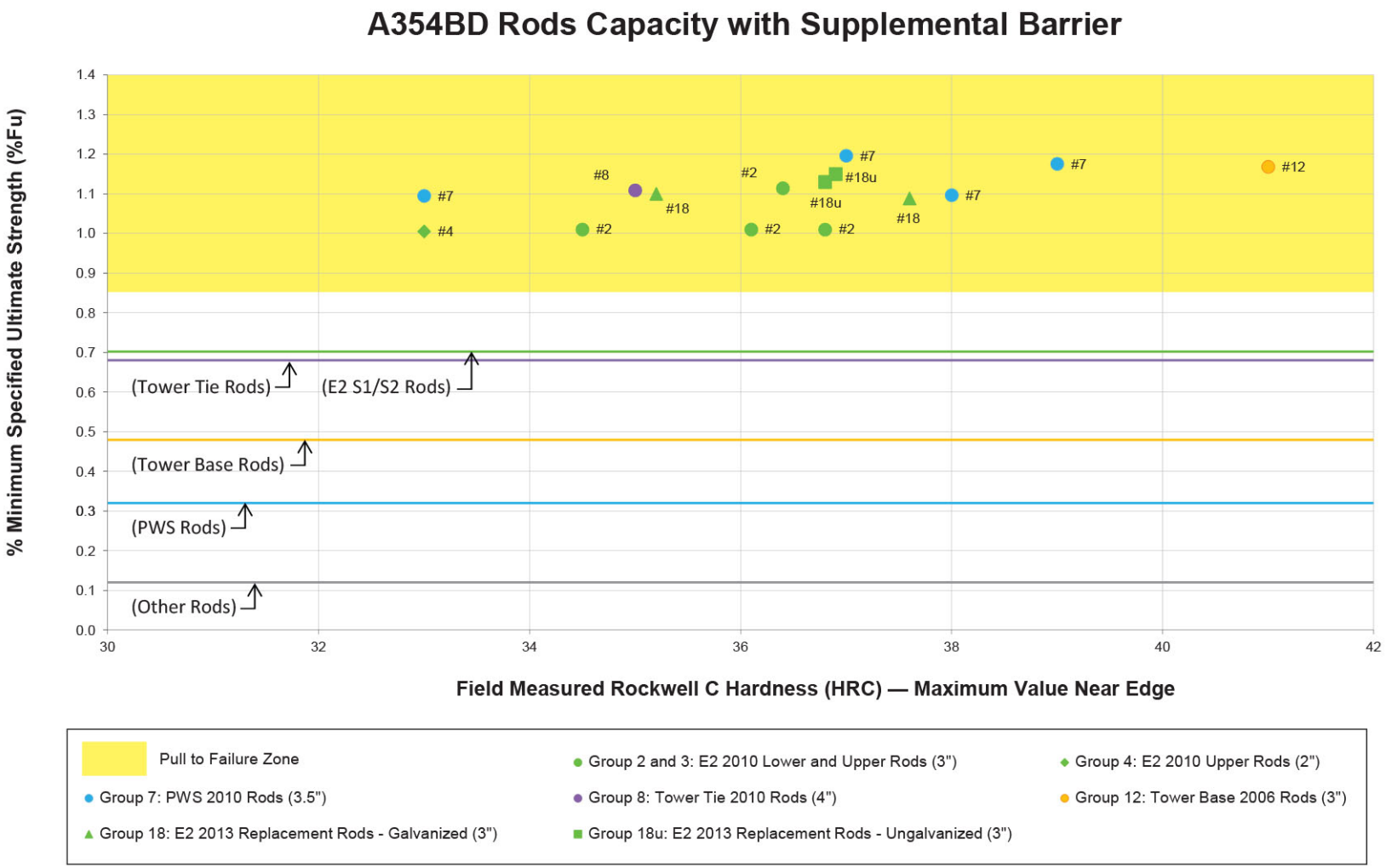
Test V — Raymond Test Results



Testing Program Main Results

- 2008 A354BD: Rods no longer in use on the SAS
  - **Test IV replicated the field results with the rods failing at 0.70Fu when exposed to water thereby validating Test IV protocol.**
  - Top and bottom segments of the bolts failed at same load level of 0.70Fu.
- 2006/2010/2013 A354BD: Rods in service
  - **In Test IV, all rods failed at 0.80Fu or greater indicating that the SCC threshold of these rods can be conservatively set at 0.75Fu.**
  - **Test V and Test VI corroborate the threshold established in Test IV.**
  - Rods with threads rolled after heat treatment exhibit superior resistance to SCC than cut threads.
  - Rods with higher toughness (higher CVN) exhibit higher SCC threshold.
  - The threshold of both galvanized and ungalvanized 2013 rods in Test IV is at or greater than 0.80Fu.

A354BD Rods Capacity with Supplemental Barrier



Recommendations

- Galvanized A354BD rods on the SFOBB-SAS shall be protected from exposure to water with one supplemental barrier
  - *dehumidification*
  - *paint system*
  - *Grout*
  - *grease caps*
- Replacement or reducing the pre-tension level of the A354BD Rods is not necessary
- The A354BD rods on the SAS shall be inspected and maintained per the SAS maintenance manual.

Recommendations (Continued)

Survey of A354 BD Rods in SAS Supplemental Moisture Barrier

Rod Data			As- Built Protection Barrier				
Group ID	A354 BD Bolt Location	Tension (%Fu)	Dehumidified	Primer	Grout	Grease Caps	Supplemental Moisture Barrier
2	Pier E2 Shear Key and Bearing Lower Anchor Rods	70			•	•	✓
3	Pier E2 Shear Key Anchor Rods — Top Housings	70					X
4	Pier E2 Bearing Anchor Rods — Top Housing	70					X
5	Pier E2 Bearing Bushing Bolts	61		•			✓
6	Pier E2 Bearing Retainer Ring Bolts	40		•			✓
7	PWS Strand Anchor Rods	32	•				✓
8	Tower Saddle Tie Rods	68	•				✓
9	Tower Saddle Turned Rods	45	•				✓
10	Tower Saddle Grillage Bolts	10	•				✓
11	Tower Outrigger Rods	10		•			✓
12	Tower Anchorage Anchor Rods (75 Dia.)	48	•		•		✓
13	Tower Anchorage Anchor Rods (100 Dia.)	37	•		•		✓
14	East Saddle Anchor Rods	10	•				✓
15	East Saddle Tie Rods	20	•				✓
16	Cable Bracket Anchor Rods	16		•			✓

Recommendations (Continued)

- Supplemental Barrier to the E2 Upper Bearings and Shear Key Rods shall be provided.

Conclusions

- The testing program established a conservative threshold in an aggressive salt water environment equal to 0.75Fu for the A354BD rods currently in service on the SFOBB-SAS.
- The pre-tension of A354BD rods on the SAS ranges from 0.10Fu to a maximum of 0.70Fu which is less than the threshold of 0.75Fu.
- With supplemental barrier, the capacity of A354BD Rods will be at least 1.0Fu
- Based on the above it is concluded that the A354BD rods in service on the SAS are safe as they are not susceptible to SCC at the design loads and conditions.

Maintenance Review

Maintenance Peer Review by Other Bridge Operators

- Peer Review to Advise on Recommended Maintenance Program

- Review by Members of the International Cable Supported Bridge Operators Association (ICSBOA), including
  - Barry Colford, Chief Engineer & Bridgemaster, Forth Road Bridge
  - Jim Gibson, Highway Maintenance Manager, Tsing Ma Bridge
  - Leif J. Vincentsen, Managing Director Sund & Bælt Partner A/S and Technical Director, Sund & Bælt Holding A/S
  - Chris Saladino, Facility Engineer of the Bronx-Whitestone Bridge, MTA Bridges and Tunnels
  - Ewa Bauer, Chief Engineer, Golden Gate Bridge

Maintenance Peer Review

- Review pertinent technical documents
- Bridge Site visit in mid October, 2014
- Reviewers will focus on prior concerns of corrosion, painting, post-tensioning, and joints.
- Finding are expected back to the Toll Bridge Program Oversight Committee by end of 2015.

Risk Management

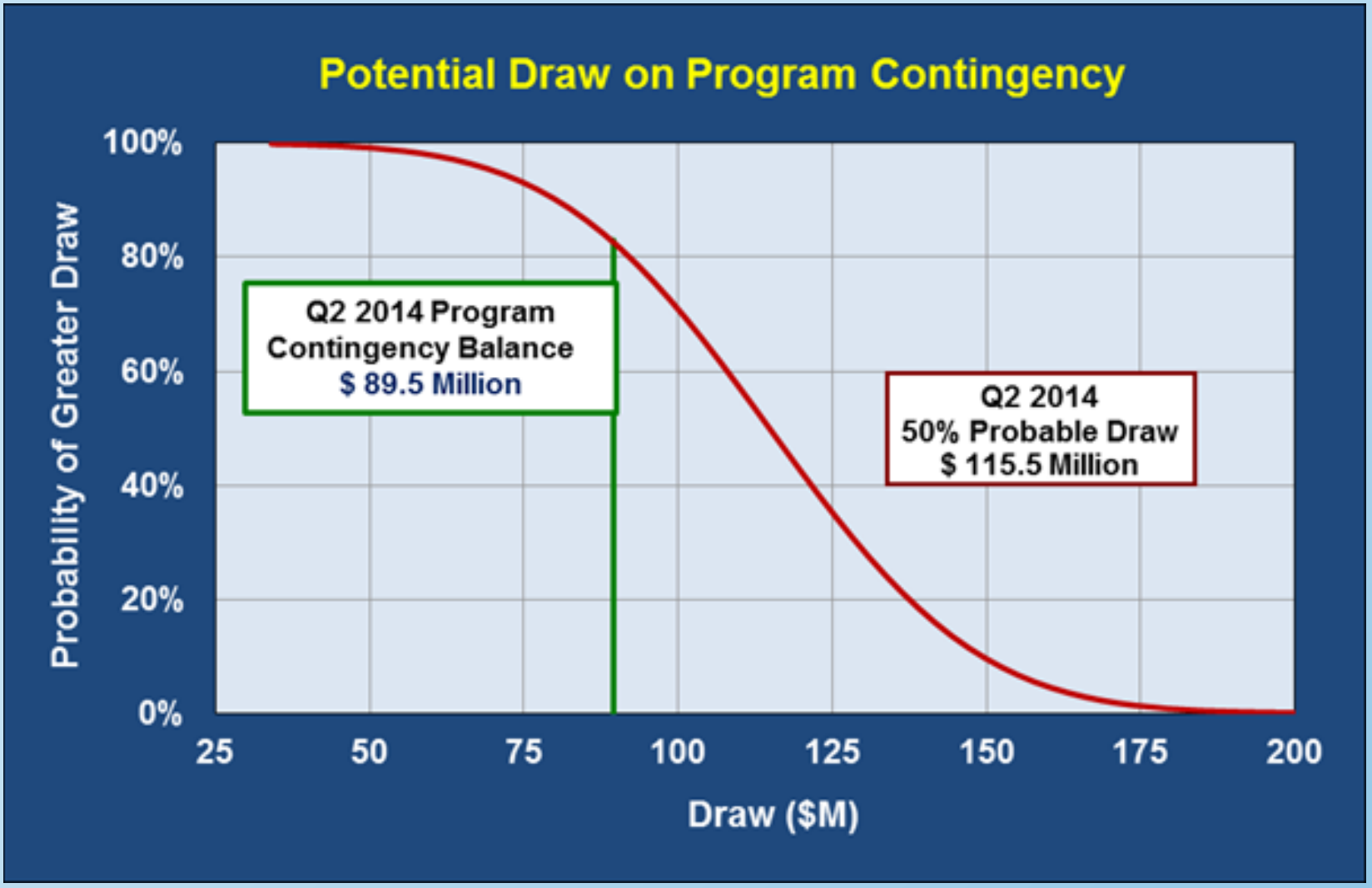
Comprehensive Risk Management Program and Program Contingency

- The Toll Bridge Seismic Retrofit Program has a comprehensive risk management program to assess program and project risks.
- The program identifies and quantifies risks and their probabilities, which are incorporated into the project forecasts.
- Staff continues to review risks and work to reduce the probabilities of these risks from occurring and their impacts should they occur.
- A program contingency was established for the Seismic Retrofit Program to address project risks.
- The contingency has fluctuated over time as project risks are mitigated and challenges addressed.

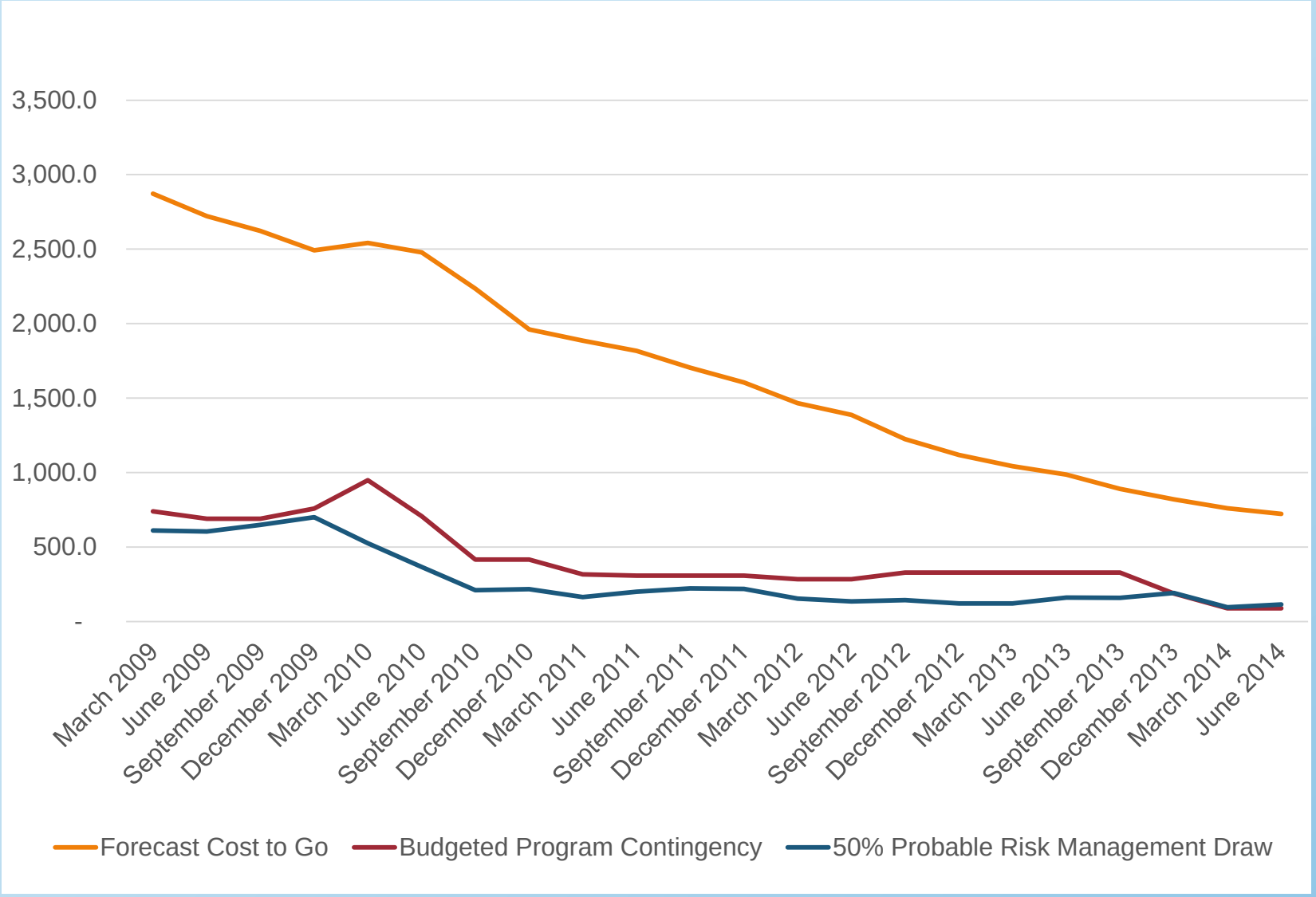
Risks – Retired and Active

- Retired Risks
  - Fabrication and Construction Challenges
  - Past Schedule Delays
- Active Risks
  - Capital Outlay Support
  - Environmental Challenges during Dismantling
    - Bird Nesting Deterrence
    - Lead Abatement
    - Permitting
    - Marine Impacts
  - Pier Removal

2nd Quarter 2014 Potential Draw on Program Contingency



SRP Program Contingency Drawdown



Risks Mitigations

A. Hold the line on current COS budget.

B. Pursue steps to reduce pier removal costs: implode deep water piers, retain shoreline piers for public access, etc.

C. Work with environmental agencies to expedite demolition work while protecting habitat and species.

Pier Reuse Option

SRP Budget History

SRP Budget		$ in Millions
a.	AB 144 Baseline Budget (2005)	8,685
b.	Dumbarton/Antioch Budget Revision (2010)	750
c.	Amended SRP Budget [a+b]	9,435
d.	Withdrawal of Dumbarton/Antioch Bid Savings (2010)	<353>
e.	Withdrawal of Misc. SRP Program Savings (2013)	<130>
f.	Total Savings [d+e]	<483>
g.	**Current SRP Budget [c-f] (2014)**	**$8,952**