Docket:		R.11-02-019
Exhibit Number	:	DRA-04
Commissioner	:	Florio
ALJ	:	Bushey
Witness	:	Rondinone
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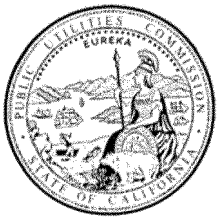

DIVISION OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

DRA REPORT ON THE PIPELINE SAFETY ENHANCEMENT PLAN OF PACIFIC GAS & ELECTRIC COMPANY

Implementation Plan Analysis and Recommendations

San Francisco, California
January 31, 2012

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I. Executive Summary

BEAR has reviewed the PG&E Decision Tree, Decision Tree Justification, and PG&E's expert's report for the DRA. The Decision Tree was evaluated for errors, risk assessment, and change in scope, with a focus on which segments should be prioritized for Phase 1 projects. Phase 2 outcomes were not analyzed.

The PG&E Decision Tree was found to require adjustments that address pipeline safety and segment priority. BEAR recommends the following adjustments:

Subpart J testing was incorrectly used to evaluate potential pipe joint fabrication threats. Because documentation of a Subpart J test should not be a deciding point for taking action on a fabrication or construction threat, BEAR recommends to remove Subpart J testing as a decision criteria from the Fabrication and Construction portion, part 2, portion of the Decision Tree.

BEAR recommends that, with the exception of fabrication and construction threats (joints between segments), the first action to mitigate risk should be a Subpart J test, in-line inspection (ILI), and/or a remaining life fatigue analysis.

Not all Class 2 areas should be treated with equally high priority as HCA or Class 3 and 4 areas, as is the case in PG&E's original Decision Tree. Instead, BEAR recommends that only Class 2 segments that are adjacent to or contiguous with Class 3 segments should receive such treatment.

Figures 1a, 1b, and 1c show the three parts of the decision tree, with both the original PG&E and modified BEAR decision points and outcomes.

Additionally, PG&E identifies a large number of pipe segments for either a replacement or testing that are not consistent with their own Decision Tree results. For example, nearly 100 segments comprising over 7 miles of pipeline were identified by PG&E as part of their integrity management plan, yet were flagged for replacement under this project.

These modifications recommended by BEAR result in a pipeline evaluation that has less risk than the PG&E decisions, while simultaneously reducing scope.

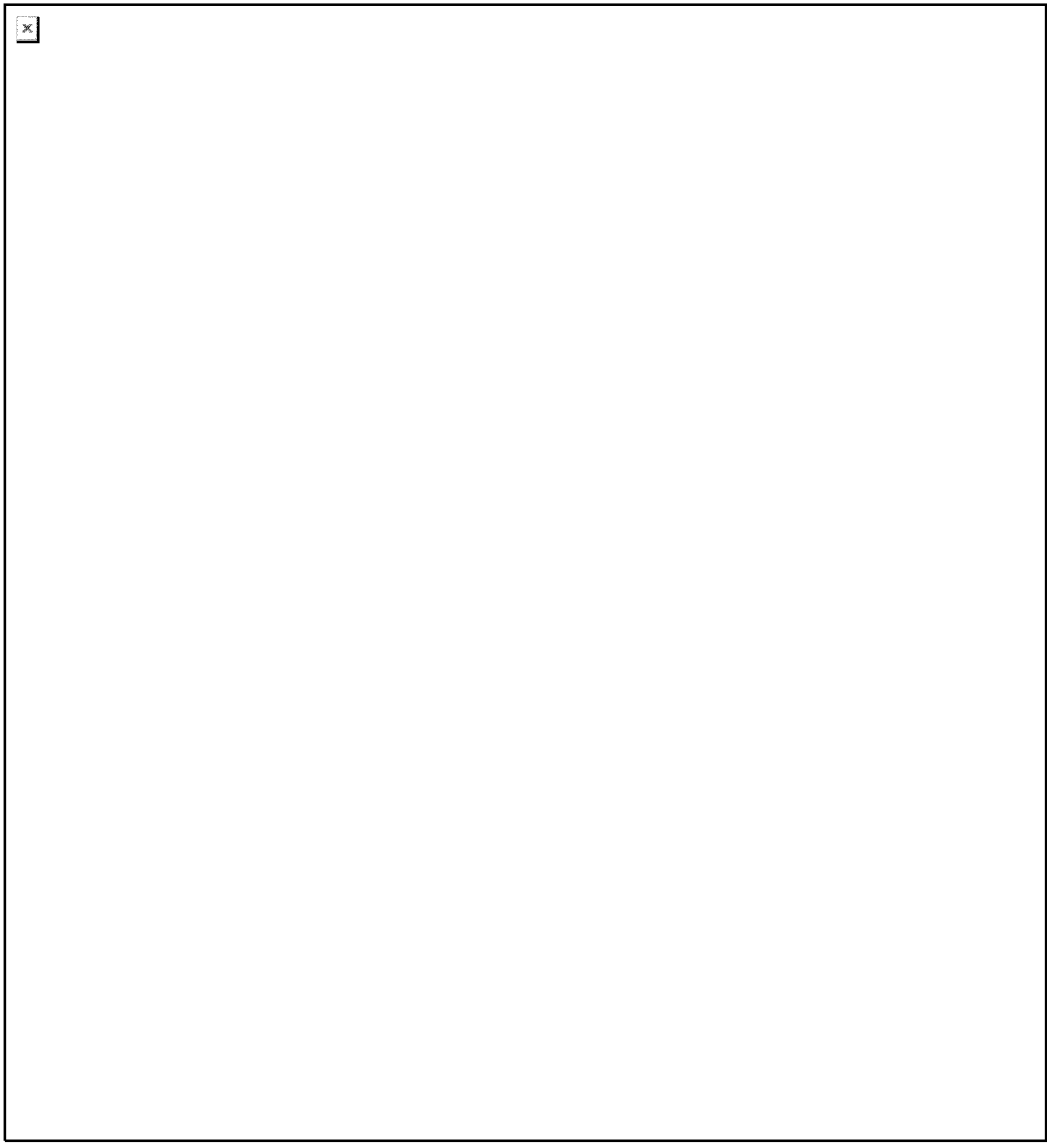

Figure 1a: Decision Tree Comparison – Manufacturing Threats

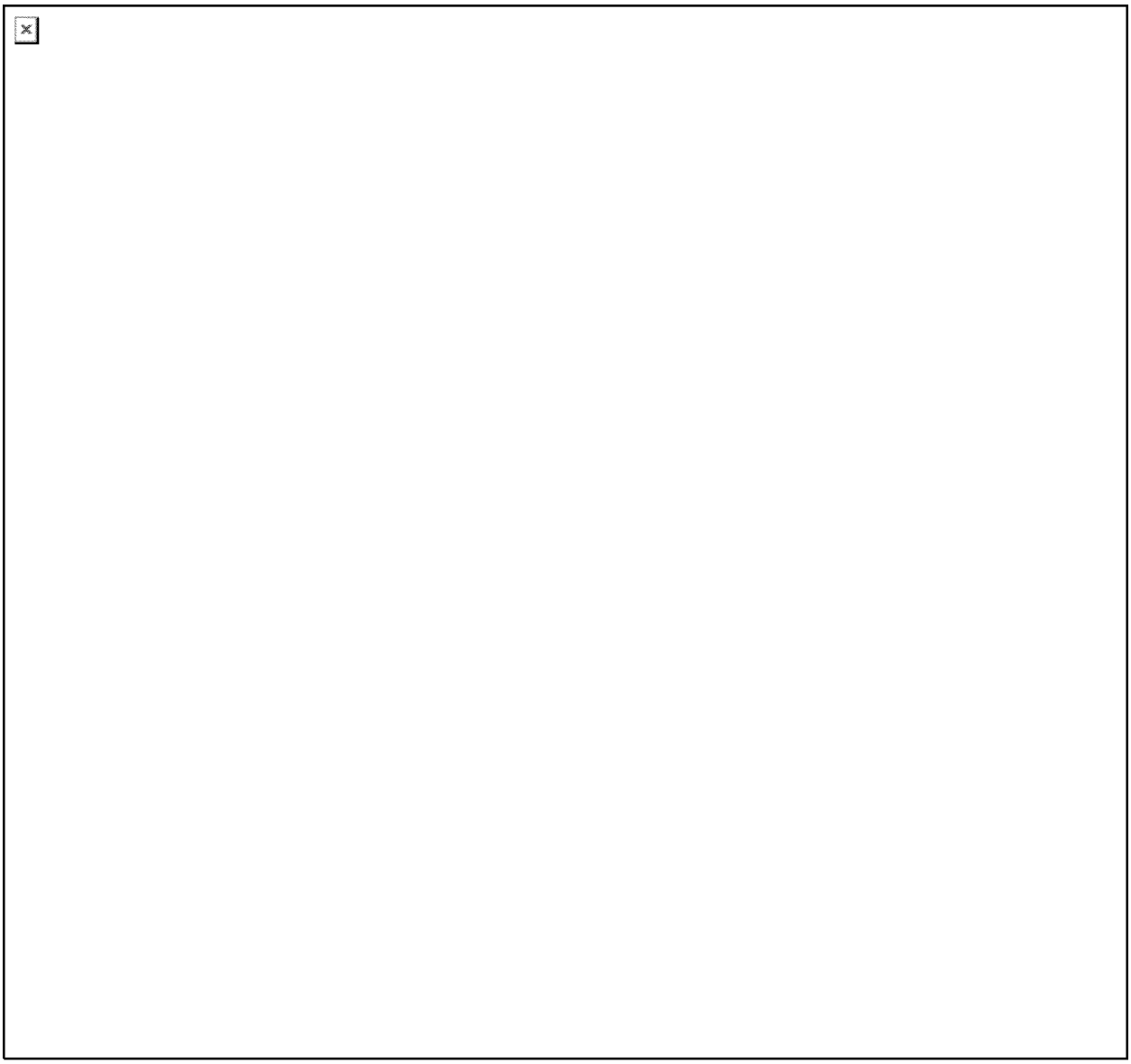

Figure 1b: Decision Tree Comparison – Fabrication Threats

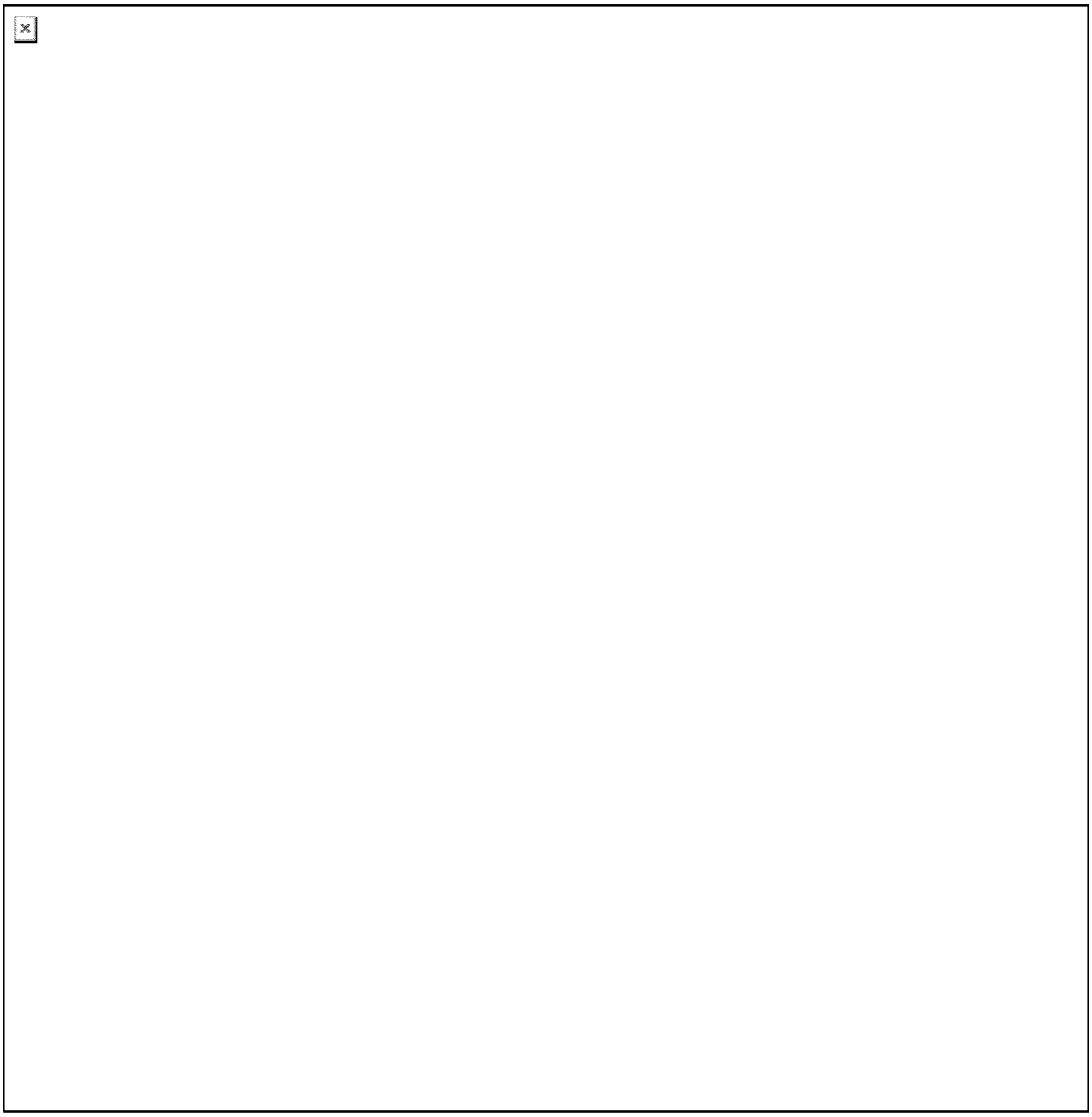

Figure 1c: Decision Tree Comparison – Corrosion Threats

II. Findings from Review of PG&E Decision Tree.

A. Overview

PG&E has developed an Implementation Plan in an attempt to conform with CPUC Decision 11-06-017[1]. The Implementation Plan uses a flow chart (the Decision Tree) to evaluate each pipe segment and determine what actions are required to bring that segment into conformance. The scope of this report is to independently verify the logic of the Decision Tree and make recommendations for improvements for Phase 1.

As PG&E and Kiefner (the independent expert hired by PG&E) explain, the organization into three main categories of threats (Manufacturing, Fabrication & Construction, Corrosion & Latent Mechanical Damage) is derived from ASME 31.8S. This categorization works well and provides a sound engineering organizational structure.

BEAR reviewed the list of specific manufacturing, fabrication, and construction methods that PG&E has identified as potentially threatening to pipeline integrity. With regard to manufacturing threats, a 1970 cutoff is used where older pipe is queried for what manufacturing method was used. After 1970, pipe manufacture would have been subject to Department of Transportation regulation and would presumably have a much lower risk of being defective.

B. Review of Manufacturing, Fabrication, & Construction Features

The PG&E Decision Tree indicates that of the pre-1970 pipe, any pipe manufactured with a single submerged arc weld (SSAW), spiral weld, low frequency electric resistance weld (LF-ERW), lap-weld, electric flash weld (EFW, by A.O. Smith), or any method giving a joint efficiency less than 1.00 requires further evaluation. However, PG&E will accept any seamless or double submerged arc welded (DSAW) pipe as not having an inherit risk of seam defects.

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[1] Public Utilities Commission of the State of California, Rulemaking 11-02-019, Decision 11-06-017.

BEAR and the larger engineering community agree that the listed seams need evaluation. For example, a report by Baker[2] identifies manufacturing defects common to LF-ERW, EFW, and lap-welded pipe. Additionally, a study by Quickel[3] documents grooved corrosion (corrosion that preferentially affects the seam weld) and hook cracks along LF-ERW seams, and lack-of-fusion defects in SSAW seams. These type of defects can lead to premature failure of a pipeline and thus require evaluation.

Under Fabrication & Construction Threats, PG&E has identified a number of joints, bends, and weld types that they consider potentially threatening to integrity or an obstacle to in-line inspection (ILI) equipment. In reviewing available literature on these pipeline features, BEAR found good cause for removal.

Wrinkle bends contain wrinkles along the inner radius of a bend where the pipe material has undergone compression, and the size and spacing of the wrinkles is addressed in ASME B31.8. A study by Alexander and Kulkami[4] indicates that the wrinkles form stress concentrations which are susceptible to fracture under flexure. Similarly, an incident report for Southern Natural Gas[5] documents a fracture in a wrinkle due to soil erosion applying a bending load.

Miter bends are formed when the ends of two adjoining pipes have been cut at an angle and welded together. A 2009 report by Battelle[6], in which miter bends were

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[2] Michael Baker Jr., Inc., "Low Frequency ERW and Lap Welded Longitudinal Seam Evaluation," Office of Pipeline Safety TTO-05, April 2004. http://primis.phmsa.dot.gov/gasimp/docs/TTO05_LowFrequencyERW_FinalReport_Rev3_April2004.pdf

[3] Quickel, G.T., Rollins, B.C., Beavers, J.A., "Analysis of Seam Weld Related Pipeline Failures," Materials Science & Technology Conference and Exhibition 2008. http://www.dnvcolumbus.com/files/publications/5e18.pdf

[4] Alexander, C., and Kulkami, S., "Evaluating the Effects of Wrinkle Bends on Pipeline Integrity," Proceedings of IPC2008 (Paper No. IPC2008-64039), 7th International Pipeline Conference, September 29 – October 3, 2008, Calgary, Alberta, Canada.

[5] Murphy, D., Turner, D., Taylor, C., "Failure Investigation Report – Southern Natural Gas, 2nd North Main Pipeline, Louisville, MS," Office of Pipeline Safety, 2011-06-09. http://www.phmsa.dot.gov/staticfiles/PHMSA/PipelineFailureReports/SNG%20GT%20MS%202010-01-06%20508.pdf

[6] Feier, I., Leis, B., Xiankui, Z., "National Grid Miter Joint Testing," Battelle report prepared for National

subjected to pressure and bending tests, and a complimentary report by Kiefner[7], both indicate that miter joints up to 8° are not weaker than the base material. However, DOT regulation restricts miter joint usage[8], and the joints can present obstacles to ILI equipment[9].

Dresser couplings, and mechanical couplings in general, are susceptible to failure due to pipeline movement causing misalignment or pull-out, and the elastomeric seals degrading over time. A report by the Railroad Commission of Texas[10] documents several incidents of mechanical fitting failures. Although that report covers distribution pipelines, the modes of failure apply to larger transmission lines as well.

The internal geometry of telescoping expansion joints is likely to pose a problem for ILI equipment while, at the same time, expansion joints will not necessarily be able to mitigate pipeline damage due to soil movement[11].

Welding methods prior to approximately 1940 are more likely to be defective due to inferior welding and inspection practices. The use of Bell-Bell-Chill Ring and Bell-Spigot welds coincides with this time frame. For example, a 2003 PG&E repair to a Bell-Bell-Chill Ring weld noted that "...as expected large amounts of slag were present both in the area to be repaired and in the adjacent weld,"[12] therefore a conservative action would

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Grid, April 2009.

[7] Kiefner, J., Rosenfeld, M.J., "Rationale for Granting a Waiver to Permit Operation of National Grid's Clove Lakes Pipeline at an MAOP of 560 psig," Kiefner & Associates, Inc, report prepared for National Grid, May 2009.

[8] 49 CFR Subpart E - 192.233

[9] Wint, D., "Difficult to Pig Pipelines," Appalachian Underground Corrosion Short Course, Pipeline Integrity Management, May 2011.

[10] "Study Report on Compression Type Couplings," Railroad Commission of Texas, Pipeline Safety Section, unknown. http://www.rrc.state.tx.us/forms/reports/TXcouplingrpt.pdf

[11] O'Rourke, M.J., Liu, X.J., "Failure Criterion for Buried Pipe Subjected to Longitudinal PGD: Benchmark Case History," Proceedings of the 5th U.S.-Japan Workshop on Earthquake Resistant Design for Lifeline Facilities and Countermeasures Against Soil Liquefaction, Snowbird, UT, Technical Report NCEER-94-0026, Multidisciplinary Center for Earthquake Engineering Research, Buffalo, NY, pp. 639-652.

[12] Redacted correspondence, Subject: Line 132 – Alma Weld Repair, June 2003.

be to replace or retrofit these welds. Additionally, the internal backing rings may present an obstacle to ILI equipment.

Section 3 of the Decision Tree addresses Corrosion and Latent Mechanical Damage Threats. There is only a single outcome on this portion of the Decision Tree that relates to Phase 1: C2. The only change recommended to Section 3 of the Decision Tree is the use of Class 2-4 as high priority. Instead, a connected Class 2 (see section 3.1 of this testimony) is recommended.

In summary, BEAR agrees that the threats identified in PG&E's Decision Tree require mitigation[13]. Note that only Phase 1 outcome of the Decision Tree have been specifically addressed. Hase 2 outcomes will be analyzed in future work.

C. Findings with Regard to Segment Prioritization

A review of the logic embodied in the Decision Tree shows that PG&E will prioritize Phase 1 work by focusing on pipe that doesn't have a Subpart J test, is in a Class 2-4 or HCA, and operates above 30% SMYS. However, per CPUC Decision 11-06-017 Order #4, higher priority should be given to "...segments located in Class 3 and Class 4 locations and Class 1 and Class 2 high consequence areas, with pipeline segments in other locations given lower priority."

Prioritization of a segment with regard to testing may have three categories: a valid Subpart J test is documented (lowest risk), a hydrostatic test is documented but doesn't meet Subpart J requirements (intermediate risk), and no hydrostatic test is documented (highest risk). Given that the CPUC ordered that "segments with the highest risk, however, must be tested or replaced first,"[14] a Decision Tree query for non-Subpart J tests is required.

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ftp://ftp.cpuc.ca.gov/Gas_Pipeline_Safety/I1102016_Investigation_Into_PG_and_E_Pipeline_Records/PG_and_E_July_12_2011_Amendment_to_Appendices_B_and_C_-_Redacted_DOC_110710372/Chapter_6C/10%20Sub-Index%2010%20-%20ECDA/P3-24033.pdf

[13] PG&E August 26, 2011 Testimony in R.11-02-019, Attachment 3A.

[14] D.11-06-017 Ordering Paragraph 9, p.34.

D. Findings of Uncertainties in Database

Finally, while reviewing the Decision Tree and PG&E database (received as a 25,000+ row spreadsheet), some possible data-entry errors were found that could interfere with applying the Decision Tree.

Many fields are blank. While it may be expected that PG&E will fill in the missing data as their record review proceeds, the empty fields in the database reviewed by BEAR reduce the accuracy of the results from the modified Decision Tree because blank fields are treated conservatively.

Related to this point is that the Subpart J field "Sub_J62411" is partially dependent on the "MAOPrec430" field, as explained by PG&E:[15]

> The "Sub_J62411" data was populated by calculating the ratio of recorded test pressure to the MOP relative to class location. For Class locations 1 and 2, this needed to be equal to or greater than a 1.25 to yield a Y for yes, and for class locations 3 and 4, this needed to be equal to or greater than a 1.5 to yield a Y for yes; otherwise it was populated with an N for no. All Y data needed to also be shown as "complete," blank, or "partial" in the "MAOPrec430" column to receive a Y; otherwise, the were given an N for no. A special letter "T" was used to document where a previous test was conducted at a pressure level that does not meet today's standards. A "T" is treated as a No in the decision tree analysis.

As the database continues to get updated, if the blank MAOPrec430 fields are populated with something other than "complete" or "partial," the Sub_J62411 result may change. With regard to the existing data, it appears that the MAOPrec430 field is dependent on the interpretation of what constitutes good data, and this constitutes an uncertainty until the interpretation criteria is known.

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[15] PG&E Response dated January 9, 2012 to DRA data request 45, question 4(b) in R.11-02-019.

Finally, of the test and date fields that are populated, many of the test dates precede the installation dates (sometimes by decades). Because the installation date is queried by the original Decision Tree and the test date is queried by the modified Decision Tree from BEAR, it will be necessary to reconcile these conflicts before using the Decision Tree results.

III. Analysis and BEAR Recommendations

BEAR has several recommendations that will improve the ability of the Decision Tree to prioritize projects for Phase 1, assess risks, and reduce costs. The revised Decision Tree is provided at Attachment A. The modifications have been re-colored: modified queries are blue, and modified actions are orange and numbered with double digits.

A. Recommendation for Segment Prioritization for Phase 1

Throughout the Decision Tree, PG&E includes all Class 2 segments with higher priority HCA and Class 3 and 4 segments. PG&E verbally expressed two complimentary concerns that led to that decision: some Class 2 areas may transition into a Class 3 in the next couple years, so the initial inclusion of all Class 2 areas would prevent "project scope creep," and work projects tend to be more efficient on a cost-per-length basis as the length of the project grows[16]. Given these two concerns and the prioritization ordered in D11-06-017, BEAR recommends that the only non-HCA Class 2 segments to receive higher prioritization are those that are either adjacent to a Class 3 segment, or connected to a Class 3 by an uninterrupted series of Class 2 segments (Class 1 segments would constitute a 'gap'). Such segments are referred to as "connected Class 2" in the modified Decision Tree and would represent those segments most likely to transition into Class 3 segments in the next couple of years.

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[16] General meeting with PG&E and DRA, PG&E headquarters, December 19th, 2011.

B. Recommendation for Actions on Manufacturing Threats

In addition to the above classification prioritization, additional improvement in Phase 1 prioritization comes from two other modifications within the Manufacturing Threats branch. First is a greater reliance on fatigue analysis and second is using a wider range of strength tests as input into the fatigue analysis.

Rather than query whether a Subpart J test has been conducted (at 1H, Manufacturing Threats), the query should include any post-1955 strength test, which was when the ASA B31.1.8 standard included test pressures based on population density. The strength test results and pressure history can be put to immediate use in a fatigue analysis, the results of which would guide further action. By doing so, Phase 1 strength testing will focus on pipes with almost a completely unknown potential for flaw size. Phase 2 will address updating all tests to Subpart J standards.

In addition, it should also be noted that replacement as a default Phase 1 action has been removed from the Manufacturing Threats branch. Replacement may still occur as the result of a strength test, fatigue analysis, or a Phase 2 decision. With these modifications, manufacturing threats will lead to a Phase 1 strength test if the pipe segment has no post-1955 test results and is in a HCA, Class 3-4, or connected Class 2 area.

This set of changes does not pose an additional risk beyond the original Decision Tree, which allows a Subpart J test to accept manufacturing threats to a segment. The recommendation by BEAR simply extends the range of usable strength test data. Furthermore, if a fatigue analysis indicates a threat to integrity, an engineering decision can still be made to address that threat at any time. And, where strength test data for a fatigue analysis isn't available, high priority segments will be Subpart J tested and low priority areas will have a fatigue analysis done based on any other data available (such as strength tests at the mill and pressure cycle history).

C. Recommendation on Evaluating Fabrication & Construction Threats

Two queries in the Fabrication & Construction Threats branch raise concern. First is query 2C, which asks if an Engineering Condition Assessment (ECA) indicates a need for replacement. Details of what this assessment includes were not available, except that "Any feature whose condition is not proven satisfactory for service or would jeopardize the success of a subsequent In-Line Inspection will be removed from service"[17]. PG&E verbally confirmed that the ECA had not yet been formulated[18]. Until that time, BEAR recommends that an assessment include the potential for soil movement (seismic or otherwise).

Next is the use of a Subpart J query at 2F. BEAR is in agreement with Kiefner & Associates, Inc that the pipe features listed in the Fabrication & Construction Threats branch are primarily susceptible to failure from axial rather than hoop stresses[19]. Consequently, a hydrostatic test is not well suited for evaluating the condition of these features. For this reason, BEAR recommends removing this Subpart J query.

This modification presents a lower risk than the original Decision Tree. More segments will be flagged for Phase 1 replacement than in the original Decision Tree, and all of these additional segments will be in high priority areas. It should be noted that action F3 still includes a strength test, but it is the ILI that is most important.

D. Recommendation on Evaluating Corrosion and MD Threats

Only one outcome in the third part of the Decision Tree has a Phase 1 on outcome – C2. All of the other outcomes relate to either Phase 2 or PG&E's Integrity Management Program. Only Phase 1 outcomes have specifically addressed. Phase 2 outcomes will be studied in future work.

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[17] Pacific Gas and Electric Company Pipeline Safety Enhancement Plan, Attachment 3B, pg 3B-19.

[18] General meeting with PG&E and CPUC, PG&E headquarters, December 19th, 2011.

[19] Pacific Gas and Electric Company Pipeline Safety Enhancement Plan, Attachment 3C, pg 8.

E. Recommendation on Allowable Deviations

One anticipated deviation from the modified Decision Tree results will be the Neighboring Segment situation: when a segment which has not been flagged for a replacement or testing project by the Decision Tree is surrounded by segments which have been flagged for a project, the non-flagged segment may be included if doing so is more economical. Such a decision would be made on a project-by-project basis.

F. PG&E Data Responses Regarding the Decision Tree

PG&E provided two Data responses regarding questions on the Decision Tree. The first specifically asked "why a greater margin of safety is provided by replacement, as opposed to a Phase 1 hydrostatic test."[20] PG&E's response stated that:

> "Strength testing will confirm a margin of safety at the time of the test, but is unable to identify and address other threats to the long seam, pipe body, or girth welds, such as internal or external corrosion, likelihood for third-party damage, and external stresses from soil and other sources. The proper replacement of pipe can address all these other potential threats, as well as confirm the margin of safety for the pipe segment. The metallurgical properties of steel used for producing pipe today and construction practices used to build pipelines are significantly better than those of decades ago."

Although strength testing is not a good indicator of fabrication threats that fail under axial loading, it is a good indicator for long seam threats. And, the suggestion that corrosion threats require replacement is not consistent with PG7e's own Decision Tree – there is not one single outcome that requires replacement due to a corrosion threat. Also, not that all newly replaced pipe will require a hydrostatic test, and that the remaining life assessment will be made based upon those test results in the same fashion as if it were an existing pipe with a new hydrostatic test.

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[20] PG&7E Gas Pipeline Safety OIR Rulemaking 11-02-019 Data response to DRA Request 055-01.

PG&E correctly identified this difference in threat character, namely that hydrostatic testing produces hoop stresses, and is therefore not useful in detecting fabrication threats that are susceptible to axial stress:

> "Strength testing does not provide the same margin of safety for circumferential anomalies, like girth weld abnormalities, as it does for anomalies along the length of the pipe, like long seam abnormalities. This is because pressure testing primarily produces a hoop stress to the pipe while a girt weld's typical stress induced failure mechanism is a result of axial stresses, lateral stresses, or a combination thereof."[21]

IV. Results

The spreadsheet received by BEAR included the original Decision Tree results for every pipe segment and, in some cases, the assigned project type[22]. BEAR added a few columns that implement the revised Decision Tree and made some comparisons. These results are based on independent application of revised Decision Tree logic to the pipeline data provided by PG&E. The following table summarizes the results, where the Neighboring Segment deviation has been applied in all cases in order to give an upper bound on its effect.

Table 1: Summary of Decision Tree results and comparisons

	PG&E	PG&E: not from DT	BEAR DT Recommendation	Unique to BEAR	BEAR DT, w/ neighbor	Unique to BEAR
Replace (segments)	2797	314	788	133	910	166
Replace (mileage)	186	18	110	21	113	22
Test (segments)	3396	1362	3123	240	3336	286
Test (mileage)	783	270	472	41	502	51

[21] PG&E gas Pipeline Safety OIR Rulemaking 11-02-019 Data response to DRA Request 055-02.

[22] File received by BEAR: GasPipelineSafetyOIR_DR_DRA_008-Q28Atch01.xlsx

In the above table, the "PG&E: not from DT" column indicates the pipe segments that were assigned a project type ("REPL" or "TEST") that did not agree with the original Decision Tree result. This is a conservative count largely based on segments that had a C-action assigned from the Corrosion & Latent Mechanical Damage Threats branch, yet had a project assigned for Phase 1 (with the exception of action C2).

It should be noted that the segments and mileage in the above table are expected to change as PG&E updates its database, but the current results are a useful estimate for the relative effects of the recommendations made by BEAR.

V. Specific Project Comparisons

BEAR chose two projects to provide specific examples of how the BEAR recommendations affect the engineering decisions on a segment basis.

A. Project 103

Project 103 contains 25.2 miles in 122 itemized segments. Of these segments PG&E called for 23 replacements for 7.8 miles, and 17 tests for 2.5 miles. Of these 40 segments flagged for a project, approximately 8% did not correspond to the PG&E Decision Tree outcome. The BEAR recommended Decision Tree leads to 17 replacements for 5.7 miles, and 5 tests for 0.1 miles.

Table 2 below lists the segments for replacement and testing. Note that for the majority of segments both BEAR and PG&E arrive at the same decision. The entries in Table 2 have been highlighted as follows:

Green: PG&E Only Blue: BEAR Only Red: PG&E and BEAR both

Table 2: Comparison of PG&E vs BEAR segment actions for Route 103

	No Phase 1 Replacement Or Test	Replacement	Testing
PG&E	101, 101.1, 101.2, 101.5, 101.8, 102, 102.3, 102.7, 103, 103.5, 104, 104.5, 105, 105.6, 107, 112, 112.3, 114.3, 114.6, 115.3, 116, 117.1, 117.3, 117.5, 117.7, 117.8, 117.9, 118, 119, 122.1, 122.2, 122.3, 122.4, 122.5, 122.7, 123, 123.5, 123.7, 123.9, 123.92, 123.93, 124, 124.5, 124.6, 124.7, 124.75, 124.76, 124.8, 125.1, 125.4, 125.7, 126.0, 126.45, 126.5, 126.7, 127, 127.3, 129, 130, 130.1, 130.2, 130.3, 130.4, 130.6, 131, 132, 133, 134, 136, 136.2, 136.25, 136.3, 136.4, 136.6, 137, 138, 138.5, 140, 141, 142, 142.6, 142.8	105.3, 105.9, 108, 109, 110, 111, 113, 114, 115.1, 115.5, 120, 121, 122.6, 123.8, 126.09, 126.1, 126.2, 126.3, 126.4, 128, 135, 138.7, 139	143, 144, 144.3, 144.6, 145, 145.3, 145.8, 146, 146.3, 146.4, 146.6, 147.3, 147.5, 147.7, 148, 148.8, 151
BEAR	101, 101.1, 101.2, 101.5, 102.3, 103.5, 104, 104.5, 105, 105.6, 112, 112.3, 114.3, 114.6, 115.3, 116, 117.1, 117.3, 117.5, 117.7, 117.8, 117.9, 118, 119, 120, 121, 122.1, 122.2, 122.3, 122.4, 122.5, 122.7, 123, 123.5, 123.7, 123.9, 123.92, 123.93, 124, 124.6, 124.7, 124.8, 125.1, 125.4, 125.7, 126.0, 126.45, 126.7, 127, 127.3, 129, 130, 130.1, 130.2, 130.3, 130.4, 130.6, 132, 133, 134, 136, 136.2, 136.25, 136.3, 136.4, 136.6, 137, 138, 138.5, 138.7, 139, 140, 141, 142, 142.6, 142.8, 143, 145, 145.3, 145.8	105.3, 105.9, 108, 109, 110, 111, 113, 114, 115.1, 115.5, 122.6, 123.8, 126.09, 126.2, 126.3, 126.4, 128	101.8, 102, 126.1, 135, 151

The differences in the replacement decisions include: moving the replacement to Phase 2 due to a change in priority for a Class 2 segment (120, 121); changing from replacement to testing for manufacturing threats (126.1, 135); and simply removing the

replacement recommendation for segments that do not require Phase 2 replacement from either the PG&E or BEAR Decision Tree (138.7, 139).

The removal of the testing recommendations from Phase 1 is primarily due to recommending a remaining life assessment for possible manufacturing threats on segments that have test data that predates Subpart J testing (144, 144.3, 144.6, 146, 146.3, 146.4, 146.6, 147.3, 147.5, 147.7, 148, 148.8). In a few cases the testing recommendation was removed from Phase 1 because neither the BEAR nor the PG&E decision tree indicate testing for Phase 1 (145, 145.3, 145.8). In four segments, BEAR recommends testing uniquely for high priority manufacturing threat segments (101.8, 102, 126.1, 135). Note that for each of these segments, PG&E assigned a decision outcome of M4, which should have triggered a PG&E engineering decision of "replacement", however, 101.8 and 102 were not flagged by PG&E for replacement. This is an example of PG&E not following it's own decision tree results in a very non-conservative, high risk fashion.

B. Project 108

Project 108 contains 76.9 miles in 301 itemized segments. Of these segments PG&E called for 34 replacements for 6.7 miles, and no tests. Of these, approximately 66% did not correspond to the PG&E Decision Tree outcomes. The BEAR recommended Decision Tree leads to 61 replacements for 14.1 miles, and 2 tests for 0.3 miles.

Table 3 below lists the segments for replacement and testing. Note that for the majority of segments both BEAR and PG&E arrive at the same decision. The entries in Table 3 have been highlighted as follows:

Green: PG&E Only Blue: BEAR Only Red: PG&E and BEAR both:

Table 3: Comparison of PG&E vs BEAR segment actions for Route 108

	No Phase 1 Replacement Or Test	Replacement	Testing
PG&E	100.3, 100.7, 101, 101.1, 101.3, 102.1, 102.3, 103, 103.1, 103.3, 104, 104.1, 104.3, 105, 105.1, 105.3, 106, 106.1, 106.3, 107, 107.1, 107.2, 107.3, 108, 108.3, 108.6, 109, 110, 111, 112, 112.5, 113, 113.05, 113.1, 113.19, 113.5, 113.8, 114, 115.5, 116, 116.1, 116.3, 116.5, 116.7, 117, 120, 122, 122.1, 122.3, 123, 123.7, 123.8, 124, 124.3, 124.6, 125, 125.05, 125.1, 125.3, 126, 126.3, 127, 127.3, 128, 128.2, 128.25, 128.3, 128.4, 128.7, 128.9, 129, 129.1, 129.17, 129.2, 129.3, 129.4, 129.5, 129.55, 129.6, 130, 130.1, 130.2, 130.2, 131, 131.2, 131.22, 131.43, 131.44, 131.5, 131.51, 131.52, 131.6, 131.7, 132, 132.8, 133, 133.2, 133.3, 133.6, 134, 134.3, 134.6, 135, 136, 137, 138, 138.1, 138.2, 138.3, 139, 139.21, 140, 140.2, 140.25, 140.28, 140.3, 140.7, 140.9, 140.95, 141, 141.3, 142, 145, 146, 146.3, 146.35, 146.6, 147, 147.05, 147.1, 147.3, 148, 148.3, 149, 149.3, 150, 151, 151.3, 152, 153, 154, 154.1, 154.3, 155, 156, 157, 157.3, 158, 158.3, 159, 159.3, 160, 160.3, 160.6, 161, 161.3, 162, 167.3, 167.5, 169.5, 169.7, 169.9, 170, 171.1, 171.3, 171.5, 171.7, 171.9, 172, 172.1, 172.3, 172.5, 172.7, 172.9, 173, 173.1, 173.3, 173.5, 173.7, 173.9, 174, 174.1, 174.3, 174.5, 174.7, 174.9, 175, 175.1, 175.3, 175.5, 175.7, 175.9, 176, 176.1, 176.3, 176.5, 176.7, 176.9, 177, 177.1, 177.3, 177.5, 177.7, 177.9, 178, 178.1, 178.13, 178.15, 178.2, 178.3, 178.35, 178.4, 178.42, 178.45, 178.5, 178.55, 178.6, 178.7, 178.8, 178.9, 178.91, 179.01, 179.1, 179.2, 179.3, 179.5, 179.7, 185, 185.1, 185.3, 185.6, 185.9, 186.2, 187, 187.1, 187.15, 187.2, 187.3, 187.35, 187.4, 187.5, 187.7, 187.9, 188, 188.3, 188.5, 189, 189.5, 190, 190.5, 191, 192, 192.3, 192.4, 192.5, 192.55, 192.57, 192.6, 192.9, 194, 194.2, 194.3, 194.6, 195, 197, 197.3, 198	143, 143.3, 144, 162.2, 162.3, 162.4, 162.6, 163, 163.2, 163.3, 163.6, 164, 164.3, 165, 165.1, 165.2, 165.3, 166, 166.3, 167, 167.1, 180, 180.5, 180.7, 181, 181.3, 181.6, 181.7, 181.9, 183, 184, 184.3, 184.6, 196	None

BEAR	100.3, 100.7, 101, 101.1, 101.3, 102.1, 102.3, 103, 103.1, 103.3, 104, 104.1, 104.3, 105, 105.1, 105.3, 106, 106.1, 106.3, 107, 107.1, 107.2, 107.3, 108, 108.3, 108.6, 109, 111, 112, 112.5, 113, 113.05, 113.1, 113.19, 113.5, 113.8, 114, 115.5, 116, 116.1, 116.3, 116.5, 116.7, 117, 120, 128, 128.2, 128.25, 128.3, 128.4, 128.7, 128.9, 129, 129.1, 129.17, 129.2, 129.3, 129.4, 129.5, 129.55, 129.6, 130, 130.1, 130.2, 130.2, 131, 131.2, 131.22, 131.43, 131.44, 131.5, 131.51, 131.52, 131.6, 131.7, 132, 132.8, 133, 133.2, 133.3, 133.6, 134, 134.3, 134.6, 135, 136, 137, 138, 138.1, 138.2, 138.3, 139, 139.21, 140, 140.2, 140.25, 140.28, 140.3, 140.7, 140.9, 140.95, 141.3, 147.1, 149.3, 154.3, 155, 156, 157, 157.3, 158, 158.3, 159, 159.3, 160, 160.3, 160.6, 161, 161.3, 162, 162.3, 163.3, 164, 164.3, 165.3, 166, 166.3, 167, 167.1, 167.3, 167.5, 169.5, 169.7, 169.9, 170, 171.1, 171.3, 171.5, 171.7, 171.9, 172, 172.1, 172.3, 172.5, 172.7, 172.9, 173, 173.1, 173.3, 173.5, 173.7, 173.9, 174, 174.1, 174.3, 174.5, 174.7, 174.9, 175, 175.1, 175.3, 175.5, 175.7, 175.9, 176, 176.1, 176.3, 176.5, 176.7, 176.9, 177, 177.1, 177.3, 177.5, 177.7, 177.9, 178, 178.1, 178.13, 178.15, 178.2, 178.3, 178.35, 178.4, 178.42, 178.45, 178.5, 178.55, 178.6, 178.7, 178.8, 178.9, 179.2, 180, 181.3, 181.9, 184.3, 184.6, 185, 185.1, 185.3, 185.6, 185.9, 186.2, 187, 187.1, 187.15, 187.2, 187.3, 187.35, 187.4, 187.5, 187.7, 187.9, 188, 188.3, 188.5, 189, 189.5, 190, 190.5, 191, 192, 192.3, 192.4, 192.5, 192.55, 192.57, 192.6, 192.9, 194, 194.2, 194.3, 194.6, 195, 196, 197, 197.3, 198	122.1, 122.3, 123, 123.7, 123.8, 124, 124.3, 124.6, 125, 125.05, 125.1, 125.3, 126, 126.3, 127, 127.3, 141, 142, 143, 143.3, 144, 145, 146, 146.3, 146.35, 146.6, 147, 147.05, 147.3, 148, 148.3, 149, 150, 151, 151.3, 152, 153, 154, 154.1, 162.2, 162.4, 162.6, 163, 163.2, 163.6, 165, 165.1, 165.2, 178.91, 179.01, 179.1, 179.3, 179.5, 179.7, 180.5, 180.7, 181, 181.6, 181.7, 183, 184	110, 122

PG&E had a number of replacement segments that BEAR removed. The two reasons for these removals were: manufacturing threats that BEAR recommended remaining life assessments for (164.3, 184.3, 196) because test data was available for those segments; and the fact that neither the BEAR nor PG&E Decision Trees gave an outcome that required replacement (162.3, 163.3, 164, 165.3, 166, 166.3, 167, 167.1, 180,

181.3, 181.9, 184.6). Note that the majority of these changes do not involve a difference in engineering logic between BEAR and PG&E.

BEAR added a large number of replacement recommendation segments compared to the PG&E findings. Each one of these was due to a fabrication threat that had been disregarded by PG&E based upon a Subpart J test (122.1, 122.3, 123, 123.7, 123.8, 124, 124.3, 124.6, 125, 125.05, 125.1, 125.3, 126, 126.3, 127, 127.3, 141, 142, 145, 146, 146.3, 146.35, 146.6, 147, 147.05, 147.3, 148, 148.3, 149, 150, 151, 151.3, 152, 153, 154, 154.1, 178.91, 179.01, 179.1, 179.3, 179.5, 179.7). However, both PG&E and BEAR agree that Subpart J testing is not sufficient to identify fabrication threats and thus should not be used as a method of acceptance.

PG&E had zero segments flagged for testing in this Project 108. BEAR added two segments for testing (110, 122). In each of these segments, both BEAR and PG&E Decision Tree outcomes required Phase 1 testing (action C2). It is unknown why PG&E chose to ignore their own Decision Tree outcome in this non-conservative fashion.

VI. Conclusion

Overall, the original Decision Tree submitted by PG&E requires modification. BEAR believes the amount of segments and mileage flagged for Phase 1 replacement is excessive and that some threats are not correctly evaluated.

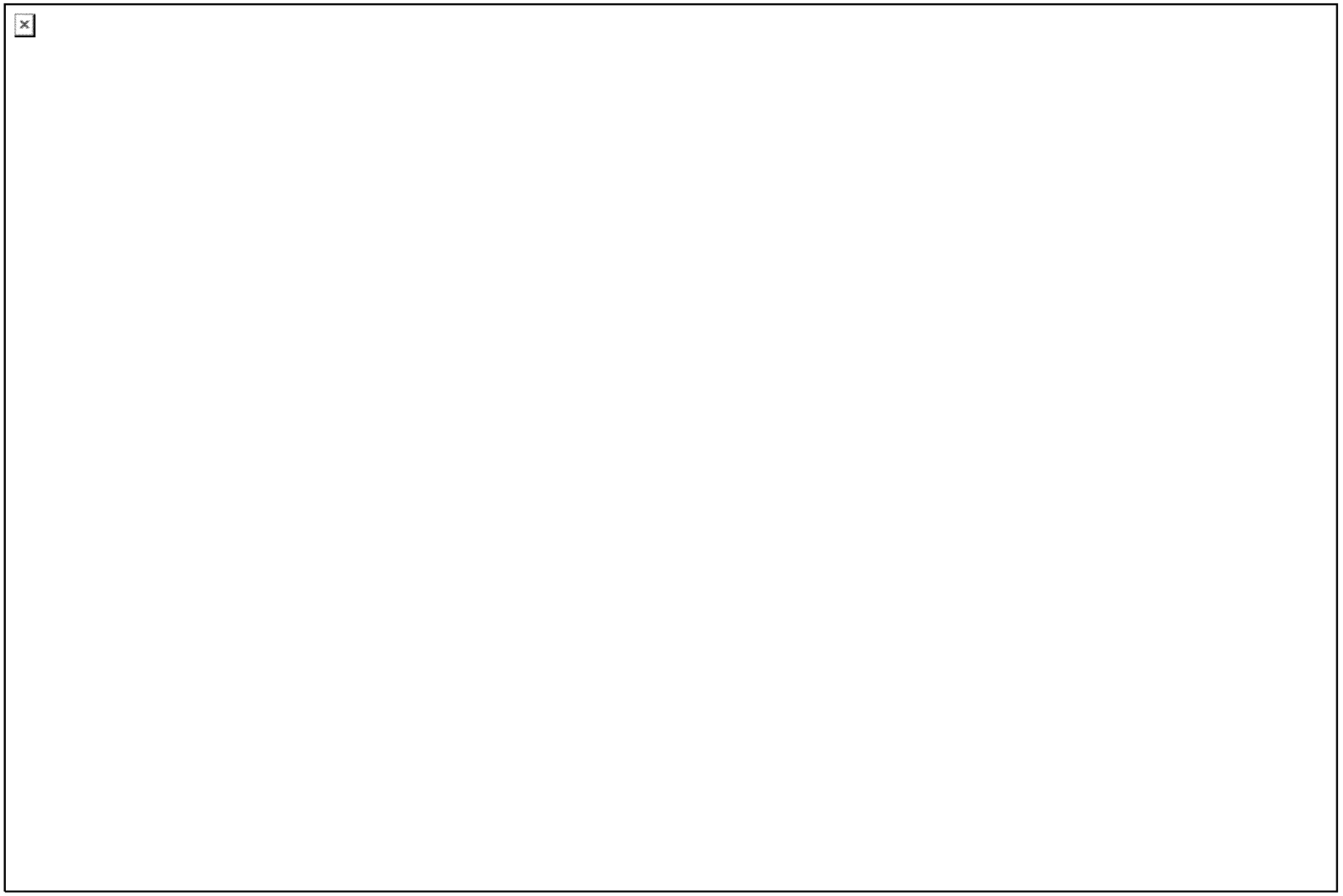
One reason for the large number of Phase 1 replacements is that PG&E identifies high priority areas as being Class 2 – 4 or HCA. BEAR recommends refining this grouping so that only Class 2 segments connected to Class 3 segments are included. This reduces the Phase 1 burden while still anticipating the possibility for population growth.

Next, because manufacturing threats are associated with the longitudinal pipe seams, they are suited for detection by hydrostatic testing. Therefore, rather than having replacement as a default action for some segments with pre-1970 manufacturing threats, BEAR recommends that these segments should initially be evaluated by fatigue analysis when possible to determine the next course of action. Only if no strength test data is available and the segment is in a high priority area should a new Subpart J test be scheduled for Phase 1. Otherwise, a low priority segment will have a fatigue analysis

done using the data available. Later, Phase 2 will be used to update all tests to Subpart J as necessary. In total, the recommended changes by BEAR reduce the Phase 1 replacements by more than 2500 segments.

Last, the threats identified under the Fabrication & Construction Threats branch tend to be circumferential features and are most susceptible to failure under axial loads, which is not a condition that Subpart J tests for. Therefore the Subpart J query has been removed from this threat evaluation, resulting in approximately 22 additional replacements with a length of 0.8 miles. Decision outcomes recommended by BEAR result in a pipeline evaluation that has less risk than the PG&E decisions, while simultaneously reducing scope.

ATTACHMENT A



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