

Huntington Beach Platform Emmy Structural Analysis

Michael Williams P.E. | Mechanical Integrity Engineering Lead



PRESENTATION OUTLINE

- Background and Platform History
- Getting The Most Out of Subsea Inspection
- Developing a Novel Approach
- Results and Path forward

Platform Emmy History

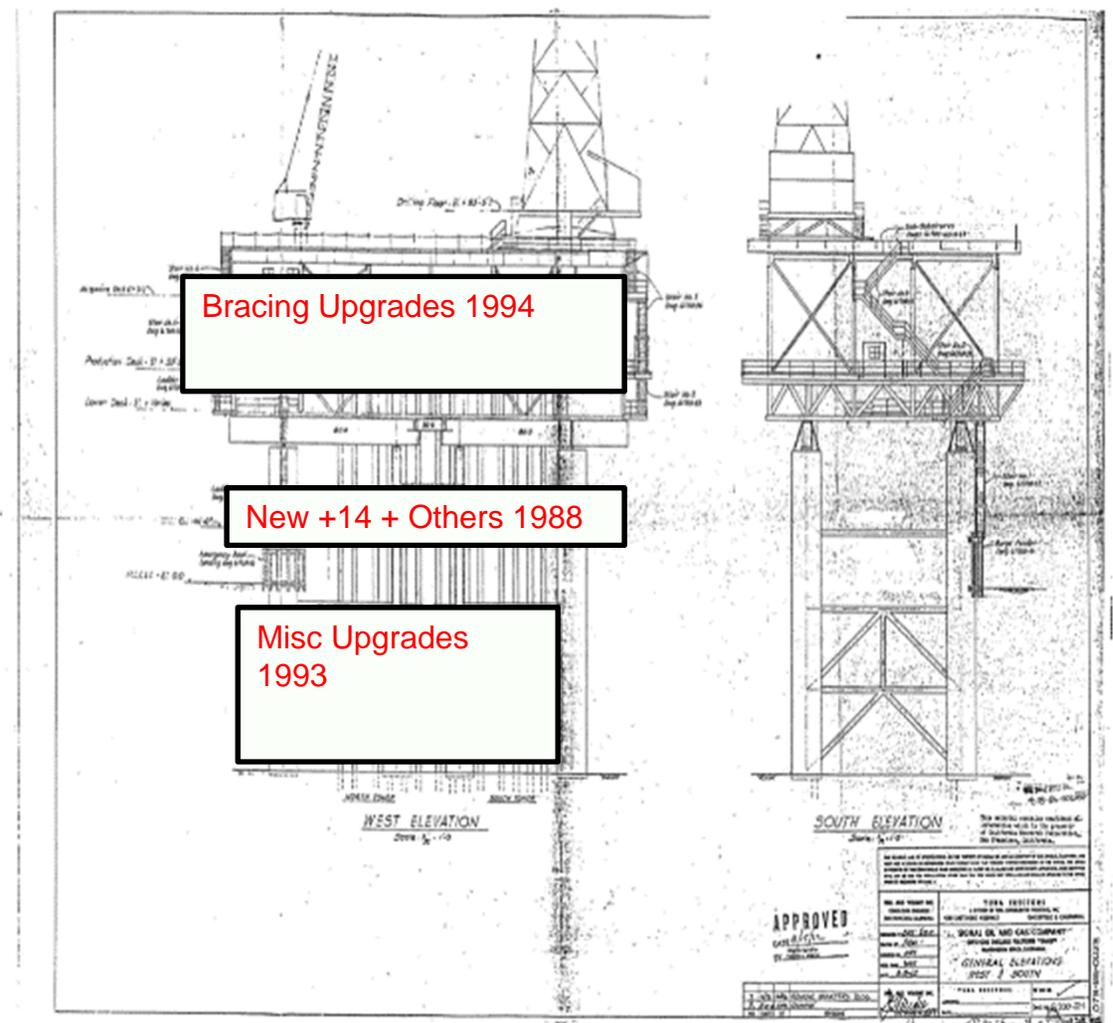
Platform Emmy was built in 1961 by Signal Oil and Gas.

1988 added additional cross member level

Shell/Aera reestablished the baseline 1991-1994

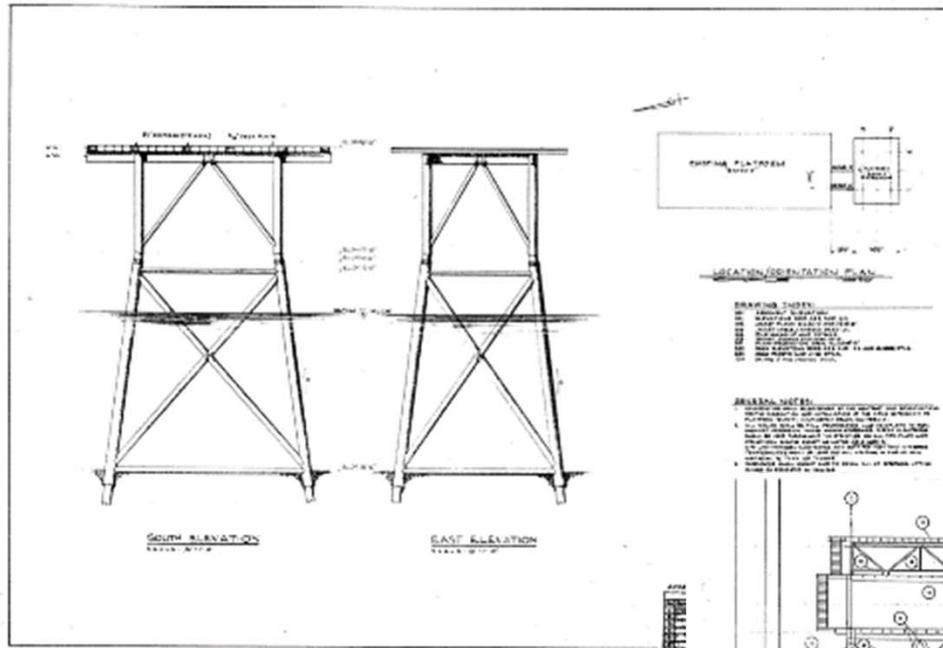
- Extensive inspections and data review
- A baseline structural response model

Structural upgrades to the topsides and other locations were completed during this time.



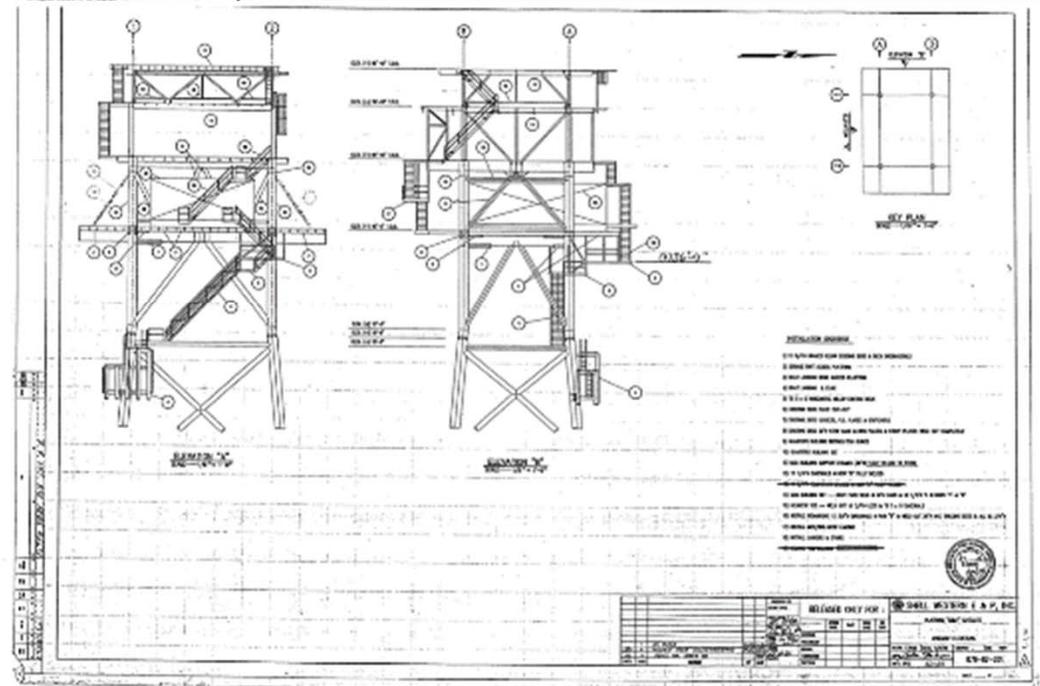
Original 1961 Construction Drawing

PLATFORM EMMY SATELLITE PLATFORM

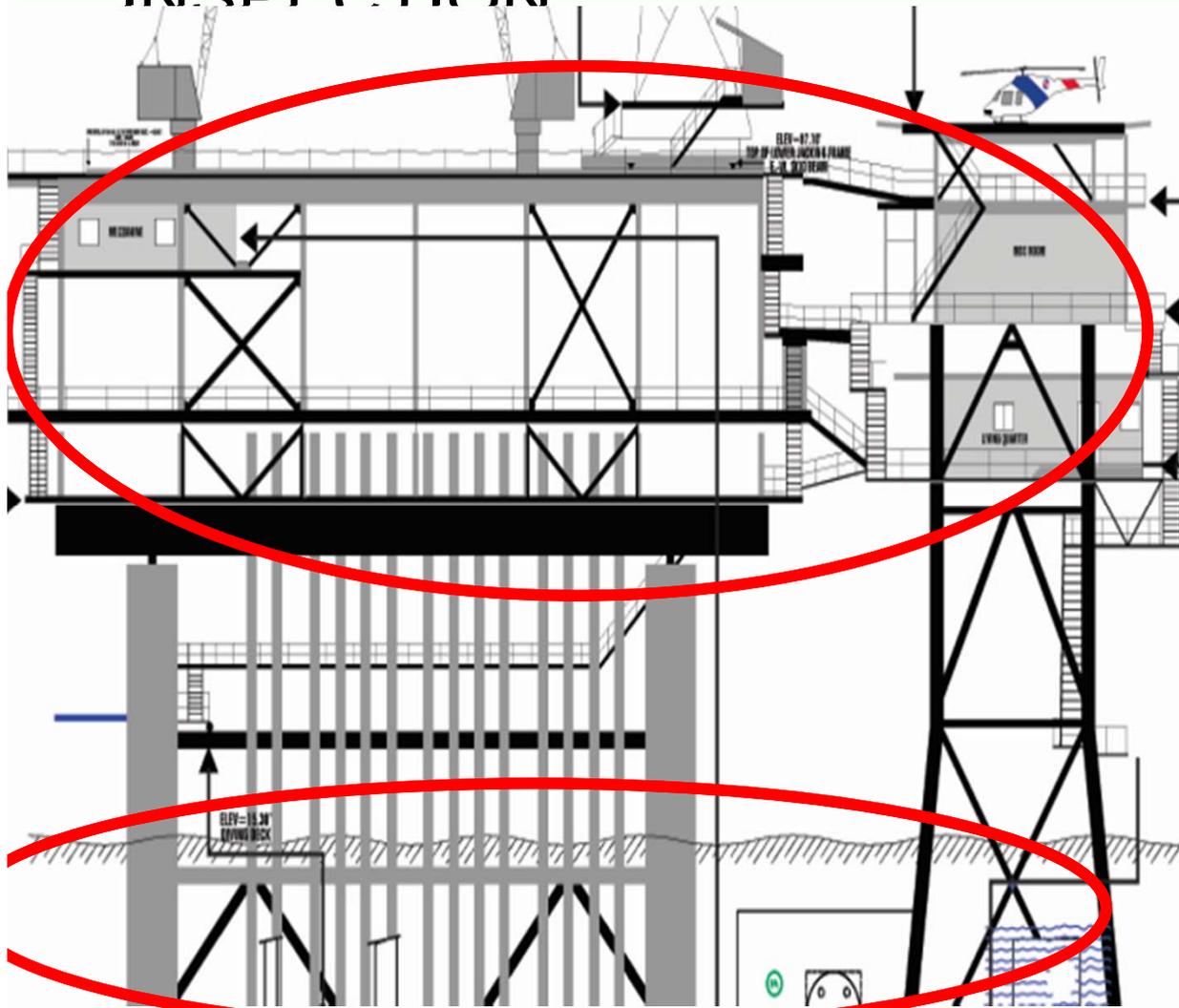


1980

1989



GETTING THE MOST OUT OF SUBSEA INSPECTION



- Level I: Topsides survey

- Level II: General underwater visual inspection
- Level III: Underwater Visual inspection of pre-selected areas
- Level IV: Underwater non-destructive examination of pre-selected areas

GETTING THE MOST OUT OF SUBSEA INSPECTION

- Platform Emmy is required to have the Level II, III & IV inspections on a 5 year cycle.
- Engineering evaluation requires detailed understanding of the past findings, inspection history, and structural analyses in order to choose the correct joints and inspection techniques
- Platform Emmy has 5000+ pages of historical analysis documentation mostly in narrative form.



GETTING THE MOST OUT OF SUBSEA INSPECTION

- Documentation arranged by year or data type, not joint or member
- Work completed across several decades by different contractors
- How can we choose the most efficient program and choose the right joints/members?

AQUEOS EXCELLENCE IN OILFIELD SOLUTIONS		Weld Mag Particle Survey #4				Job Number: 13-013	
Structure Name		Area		Block		Date: 05/28/13	
Pit Emmy		PRC		425		Inspection Level: API Level IV	
Name		Operator		Inspector (1)		Inspector (2)	
Huntington Beach		Oxy		MT Performed?		DVD Number	
Location		B3 -23 HD TO		C3.5		-23	
B3 NODE		Barr		YES		MAG 01	
Member Diameter		Weld Geometry		Overall Condition		Estimated Loss of Definition	
12"		Flat		Fair		0-25%	
General Corrosion		MUC					
W,N or M Clock Comment: (Defect, L x W x D, additional details)							
W,N & M		12:00		Slight Loss of weld definition. MUC throughout.			
M		12:30		Hole like indication in toe of weld 1/8" diameter			
W,N & M		1:00		Slight Loss of weld definition. MUC throughout.			
W		2:00		Flat weld			
N & M		3:30		LUC to MUC throughout.			
W,N & M		6:00		Slight Loss of weld definition, 3 Stringer Cap pass, Flat weld.			
W,N & M		6:30		Slight Loss of weld definition, 3 Stringer Cap pass, Flat weld.			
W,N & M		7:00		Slight Loss of weld definition, 3 Stringer Cap pass, Flat weld.			
W,N & M		9:30		Slight Loss of weld definition. MUC throughout.			
W,N & M		10:00		Slight Loss of weld definition. MUC throughout.			
W,N & M		11:00		Slight Loss of weld definition. MUC throughout.			
Photo/Sketch:							
<div style="display: flex; justify-content: space-between;"> 12:00 3:00 6:00 9:00 12:00 </div> <p>LEG</p> <p>MEMBER</p>							
Comments							
<ol style="list-style-type: none"> 1. No previous inspection report 2. Hole type indication in toe of weld 1/8" diameter 							

A NOVEL APPROACH

- Qualitative data is analyzed using summary maps
 - Visually represent what has been inspected to show the distribution of inspection data point
 - Anomaly patterns can emerge as a function of orientation and platform geometry
- Quantitative data is analyzed using a database and scoring algorithm
 - Anomaly size, Propagation, Stress ratio, Inspection history, Corrosion
 - Several thousand data points are catalogued and entered into the database
 - All data is converted from narrative to measurable fields



A NOVEL APPROACH: MEMBER HISTORY

Platform Emmy Weld Inspections											
Weld Survey											
ID #	Weld	YR/Comment 1985 - Phillips/Aminoil	YR/Comment 1987 - IDS	YR/Comment 1990 - IDS	YR/Comment 1991/1992 - Martek	YR/Comment 1993 - IDS	YR/Comment 1995 - Ecomar	YR/Comment 2003 - Divecon	YR/Comment 2008 - Divecon	YR/Comment 2013 - Aqueos	Welds discussion
#	Weld	1985 - Phillips/Aminoil	1987 - IDS	1990 - IDS	1991/1992 - Martek	1993 - IDS	1995 - Ecomar	2003 - Divecon	2008 - Divecon	2013 - Aqueos	YR/Comment
	A4(-3) HZ to B4	-	-	-	-	-	-	no damage	-	-	-
	A4(-3) HZ to A3.5	-	-	-	-	-	-	no damage	-	-	-
	A3.5(-3)	-	-	-	-	-	-	-	-	-	-
	A3.5(-3) VD to A4(-23)	-	-	-	-	-	-	-	-	-	-
	A3.5(-3) IV to A3.5(-23)	-	-	-	-	-	-	-	-	-	-
118	B3(-3) HD to A3.5(-3)	-	-	-	-	-	-	-	-	-	-
12	C4(-3) HZ to B4(-3)	no indications	-	-	1" indication 1.00	-	-	7/8" indication 2.00	1" indication 2.00	3/4" indication 2.00	-
13	C4(-3) HZ to C3.5(-3)	-	-	-	-	-	-	-	-	-	-
14	C3.5(-3)	-	-	-	-	-	-	-	-	-	-
14A	C3.5(-3) VD to C4(-23)	-	-	-	-	-	-	-	-	-	-
14B	C3.5(-3) V to C3.5(-23)	-	-	-	-	-	-	-	-	-	-
14C	C3.5(-3) VD to C3(-23)	-	-	-	-	-	-	-	-	-	-
15	C3(-3) HZ to C3.5(-3)	-	-	-	-	-	-	-	-	-	-
16	C3(-3) HZ to C3.5 SIDE(-3)	-	-	-	-	-	-	-	-	-	-
17	A2(-3) HZ to A2.5 SIDE(-3)	-	-	-	-	-	-	-	-	-	-
18	A2(-3) HZ to A1.5(-3)	-	-	-	-	-	-	-	-	-	-
19	A1.5(-3)	-	-	-	-	-	-	-	-	-	-
15A	A1.5(-3) VD to A2(-23)	-	-	-	-	-	-	-	-	-	-
15B	A1.5(-3) V to A1.5(-23)	-	-	-	-	-	-	-	-	-	-
16C	A1.5(-3) VD to A1(-23)	-	-	-	-	-	-	-	-	-	-
20	A1(-3) HZ to A1.5(-3)	-	-	-	-	-	-	1 1/4" indication 6.00	-	-	-
21	A1(-3) HZ to A1.5 SIDE(-3)	-	-	-	-	-	-	-	-	-	-
22A	B2(-3) VD to A2(-23)	-	No indications	-	-	-	-	-	-	-	-
22B	B2(-3) V to B2(-23)	-	No indications	-	-	-	-	-	-	-	-
22C	B2(-3) VD to C2(-23)	-	No indications	-	-	-	-	-	-	-	-
22D	B2(-3) HD to C1.5(-3)	6" indication	severe undercut	reinspected known damage	-	-	-	-	-	no new indication	-
22E	B2(-3) HD to A1.5(-3)	-	no indication	no indication	-	-	-	-	-	-	-
23	B2 A SIDE(-3) to B1 A SIDE(-3)	-	-	9" indication 11.1.30, 12" indication 2.30-4.00	severe 11" crack 11.1.30 and 2.00-7.00	reinspected known damage	-	-	-	15.34" indication 10-2.30, 12" indication 6.8.30 &	-
24	B2 C SIDE(-3) to B1 C SIDE(-3)	12" indication + 12" branch roadway & propagation @ ends	15" crack 9-3.00 over 1 1/4" wide + 9" crack 5.30-7.30, & propagation @ ends	38" cracks appear to have propagated 11" significant damage	reinspected known damage for comparison only	-	-	-	-	-	-
25	B1 A SIDE(-3) to B2 A SIDE(-3)	-	-	-	no indications	-	-	-	-	-	-
26	B1 C SIDE(-3) to B2 C SIDE(-3)	-	-	-	no indications	-	-	-	-	-	-
27A	B1(-3) VD to A1(-23)	no indications	cracked weld see also 25,26,27	24" crack @ 4.9.00 see also 25	-	-	-	-	-	-	-
27B	B1(-3) V to B1(-23)	-	-	see 26	no indications	-	-	-	-	-	-
27C	B1(-3) VD to C1(-23)	-	-	see 26	-	-	-	-	-	-	-
27D	B1(-3) HD to C1.5(-3)	-	-	24" crack 3.30-6.00 see also 27C	24" crack @ 4.9.00 also see 27C	-	-	-	-	-	-
27E	B1(-3) HD to A1.5(-3)	-	-	24" crack @ 3-8.00	24" severe crack @ 4.9.00 also see 27A	-	-	-	-	-	-
28	C2(-3) HZ to C2.5 SIDE(-3)	-	No indications	-	-	-	-	-	-	-	-
29	C2(-3) HZ to C1.5(-3)	-	No indications	-	-	-	-	-	-	-	-
30	C1.5(-3)	-	-	-	-	-	-	-	-	-	-
30A	C1.5(-3) VD to C2(-23)	-	-	-	-	-	-	-	-	-	-
30B	C1.5(-3) V to C1.5(-23)	-	-	-	-	-	-	-	-	-	-
30C	C1.5(-3) VD to C1(-23)	-	-	-	-	-	-	-	-	-	-
31	C1(-3) HZ to C1.5(-3)	-	-	-	-	no indications	-	-	-	-	-
32	C1(-3) HZ to B1(-3)	-	-	-	-	no indications	-	-	-	-	-
33	A6(-23) HZ to A4(-23)	-	-	-	-	-	-	-	-	-	-
34	A4(-23) HZ to A3.5(-23)	no indications, but 2 large dents 30x12x9" deep	No indications	-	-	-	-	-	-	-	-
35	A3.5(-23)	-	-	-	-	-	-	-	-	-	-
35A	A3.5(-23) VD to A4(-43)	-	-	2-1/2" crack	crack ground away leaving 2" long hole x 3/8" wide	-	-	-	-	-	-
35B	A3.5(-23) V to A3.5(-3)	-	-	2-1/2" crack, 35A	35A	-	-	-	-	-	-
35C	A3.5(-23) VD to A3(-43)	-	-	-	-	-	-	-	-	-	-

Weld History Spreadsheet

The spreadsheet contains a large grid of data points, likely representing individual inspection results for different welds and locations. A red circle highlights a specific area in the lower right quadrant of the spreadsheet, which appears to contain a summary or detailed view of a particular weld's history.

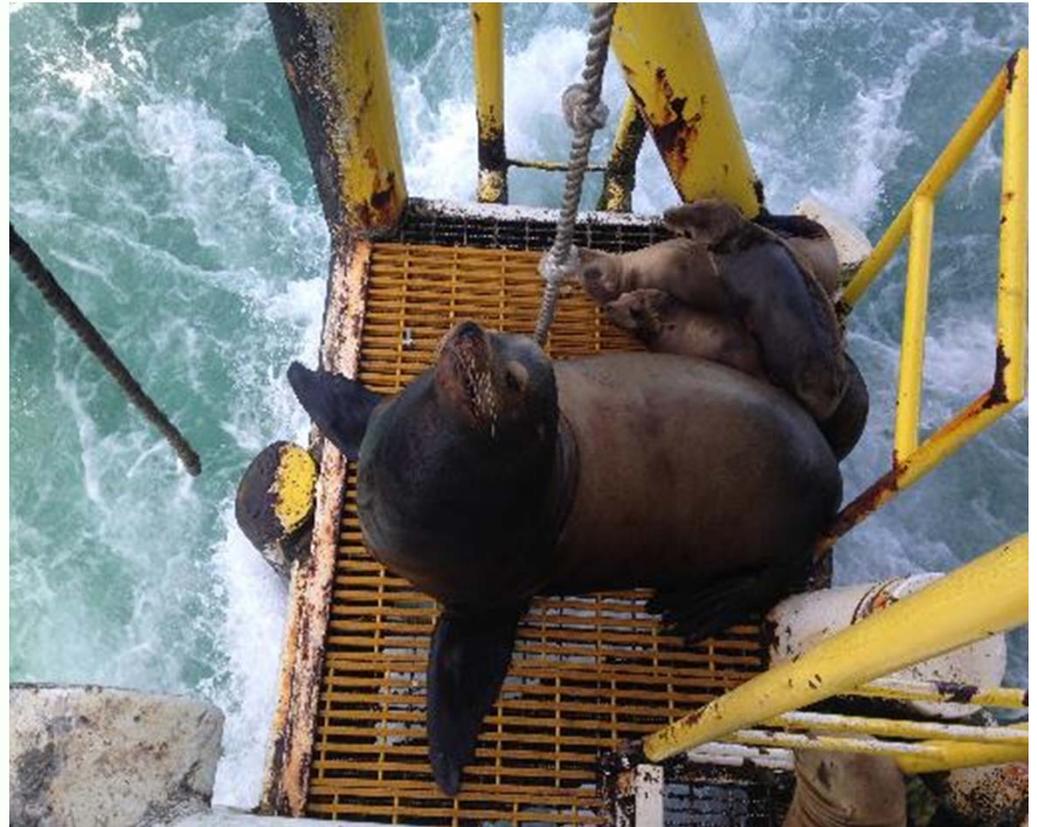
A NOVEL APPROACH: QUANTITATIVE ANALYSIS

I.D.	Diameter (in.)	Elevation (ft)	Inspected?	#	Last Inspected	Indication Size (in.)	Percent Remaining	Assumed Moment of Inertia	Assumed Area	Location of Indication (Clock)	Status	Status Rank	Orientation	Orientation Rank	Storm	DLE	SLE	Comments (Latest)	1	2	3	4	5	6	7	8
Elevation (ft)	Inspected?	#	Last Inspected	Indication Size (in.)	Percent Remaining	Assumed Moment of Inertia	Assumed Area	Location of Indication (Clock)	Status	Status Rank	Orientation	Orientation Rank	Storm	DLE	SLE	Comments (Latest)										
-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _Z	1	0	0	0	0	0	12:00 restricted access	1	11	6.4	30	5	0	0	
5	18	-3	Y	9	2013	12	78.8%	100.0%	100.0%	12:00	P	3	H _Z	1	0	0	0	12:00 restricted access	1	11	6.4	30	5	0	0	
6A	18	-3	Y	2	1992	0	100.0%	100.0%	100.0%	-	-	0	V _D	3	0	0	0	No indications	8	15	0	0	15	0	0	
6B	18	-3	Y	2	1992	0	100.0%	100.0%	100.0%	-	-	0	V	3	0	0	0	No indications	8	15	0	0	15	0	0	
6C	18	-3	Y	2	1992	0	100.0%	100.0%	100.0%	-	-	0	V _D	3	0	0	0	No indications	8	15	0	0	15	0	0	
6D	18	-3	Y	5	2013	22.75	59.8%	100.0%	100.0%	4-8:00	P	3	H _D	2	0	0	0	22 3/4" indication, propagated 3 1/4"	5	11	12	30	10	0	0	
6E	18	-3	Y	5	2013	22.75	59.8%	100.0%	100.0%	4-8:00	P	3	H _D	2	0	0	0	22 3/4" indication, propagated 3 1/4"	5	11	12	30	10	0	0	
7	12.75	-3	Y	2	1992	0	100.0%	1.0%	100.0%	-	-	0	H _D	2	0	0	0	Short indication	7	15	0	0	10	0	0	
8	12.75	-3	Y	3	2013	4.5	88.8%	1.0%	100.0%	5-6:00	P	3	H _D	2	0	0	0	No new indications	7	11	2.4	0	10	0	0	
9	12.75	-3	Y	1	1987	0	100.0%	1.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
10	12.75	-3	Y	2	2013	14.25	64.4%	1.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
11A	18	-3	Y	1	1987	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
11B	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
11C	18	-3	Y	1	1987	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
11D	18	-3	Y	2	2013	19.5	65.5%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
11E	18	-3	Y	1	1987	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
12	10	-3	Y	5	2013	1	96.8%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
13	10	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
14	12.75	-3	Y	1	1987	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
14A	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
14B	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
14C	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
15	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
16	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
17	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	
18	18	-3	N	0	1963	0	100.0%	100.0%	100.0%	-	-	0	H _D	2	0	0	0	No indications	7	15	0	0	10	0	0	

Scoring algorithm

RESULTS AND PATH FORWARD

- Created an evergreen process to quantitatively and qualitatively maintain Platform Emmy's Structural Inspection Program
- Continue vetting the program through CRC and Thomas and Beers collaborative team
- Complete inspections and feed data back into algorithm for next planning cycle



BACKUP

ABSTRACT VERSION

Platform Emmy is located a little over a mile off the coast of Huntington Beach. The platform has changed ownership several times since its construction in 1961, and each owner has aggressively maintained a preventative maintenance program on the structure. This maintenance history has resulted in a massive compendium of structural data that must be reviewed and evaluated in order to perform the most effective API RP 2A Level III and Level IV inspections.

The platform structural analysis project compiled the large data set and developed a database to perform a rigorous quantitative and qualitative analysis of the platform condition. This data was used to develop a prioritization matrix for inspection and was translated into structural summary drawings to give a visual representation of the collected data. The overall project has allowed for more intuitive inspection planning, more cost effective deployment of resources, and most importantly greater reduction in risk by prioritizing joints for subsea inspection.