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.
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?
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

### Weld History Spreadsheet

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A4(3) HZ to B4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>no damage</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>A4(3) HZ to A3.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>no damage</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>A3.5(3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>A3(3) VD to A4(23)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>A3(3) VD to A3.5(20)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
A NOVEL APPROACH: STRUCTURAL MAPS

Emmy

12Ø .250

36" Ø

(1) 0"

109

29

(1) 0"

20

28

(1) 0"

108

12Ø .250

110

111

ADD STM SLE DLE

1 - - .95

- - - 40

GRT Fy Fy Fy

18%
# A Novel Approach: Quantitative Analysis

<table>
<thead>
<tr>
<th>I.D.</th>
<th>Diameter (in.)</th>
<th>Elevation (ft)</th>
<th>Inspected?</th>
<th># Inspected</th>
<th>Indication Size (in.)</th>
<th>Percent Remaining</th>
<th>Assumed Moment of Inertia</th>
<th>Assumed Area</th>
<th>Location of Indication (Clock)</th>
<th>Status</th>
<th>Status Rank</th>
<th>Orientation</th>
<th>Orientation Rank</th>
<th>Storm</th>
<th>DLE</th>
<th>SLE</th>
<th>Comments (Latest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>9</td>
<td>1963</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>12:00</td>
<td>P</td>
<td>3</td>
<td>H₂</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>2</td>
<td>1992</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>V₀</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>No indications</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>2</td>
<td>1992</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>V</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>No indications</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>5</td>
<td>22.75</td>
<td>59.8%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>4-8:00</td>
<td>P</td>
<td>3</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>22 3/4&quot; indication, propagated 3 1/4&quot;</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>3</td>
<td>2013</td>
<td>4.5</td>
<td>80.0%</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Short indication</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>1</td>
<td>1987</td>
<td>0</td>
<td>100.0%</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>2</td>
<td>1992</td>
<td>1.0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>V₀</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>No indications</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>3</td>
<td>2013</td>
<td>14.25</td>
<td>64.4%</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>1</td>
<td>1987</td>
<td>0</td>
<td>100.0%</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>2</td>
<td>1987</td>
<td>0</td>
<td>100.0%</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>1</td>
<td>1987</td>
<td>0</td>
<td>100.0%</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>-3</td>
<td>Y</td>
<td>5</td>
<td>2013</td>
<td>0</td>
<td>100.0%</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>18</td>
<td>-3</td>
<td>N</td>
<td>0</td>
<td>1963</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>V₀</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>No indications</td>
</tr>
<tr>
<td>14</td>
<td>18</td>
<td>-3</td>
<td>N</td>
<td>0</td>
<td>1963</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>V₀</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>No indications</td>
</tr>
<tr>
<td>15</td>
<td>18</td>
<td>-3</td>
<td>N</td>
<td>0</td>
<td>1963</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>18</td>
<td>-3</td>
<td>N</td>
<td>0</td>
<td>1963</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>18</td>
<td>-3</td>
<td>N</td>
<td>0</td>
<td>1963</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>-3</td>
<td>N</td>
<td>0</td>
<td>1963</td>
<td>0</td>
<td>100.0%</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>H₀</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>

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
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.