ANADARKO PETROLEUM CORPORATION

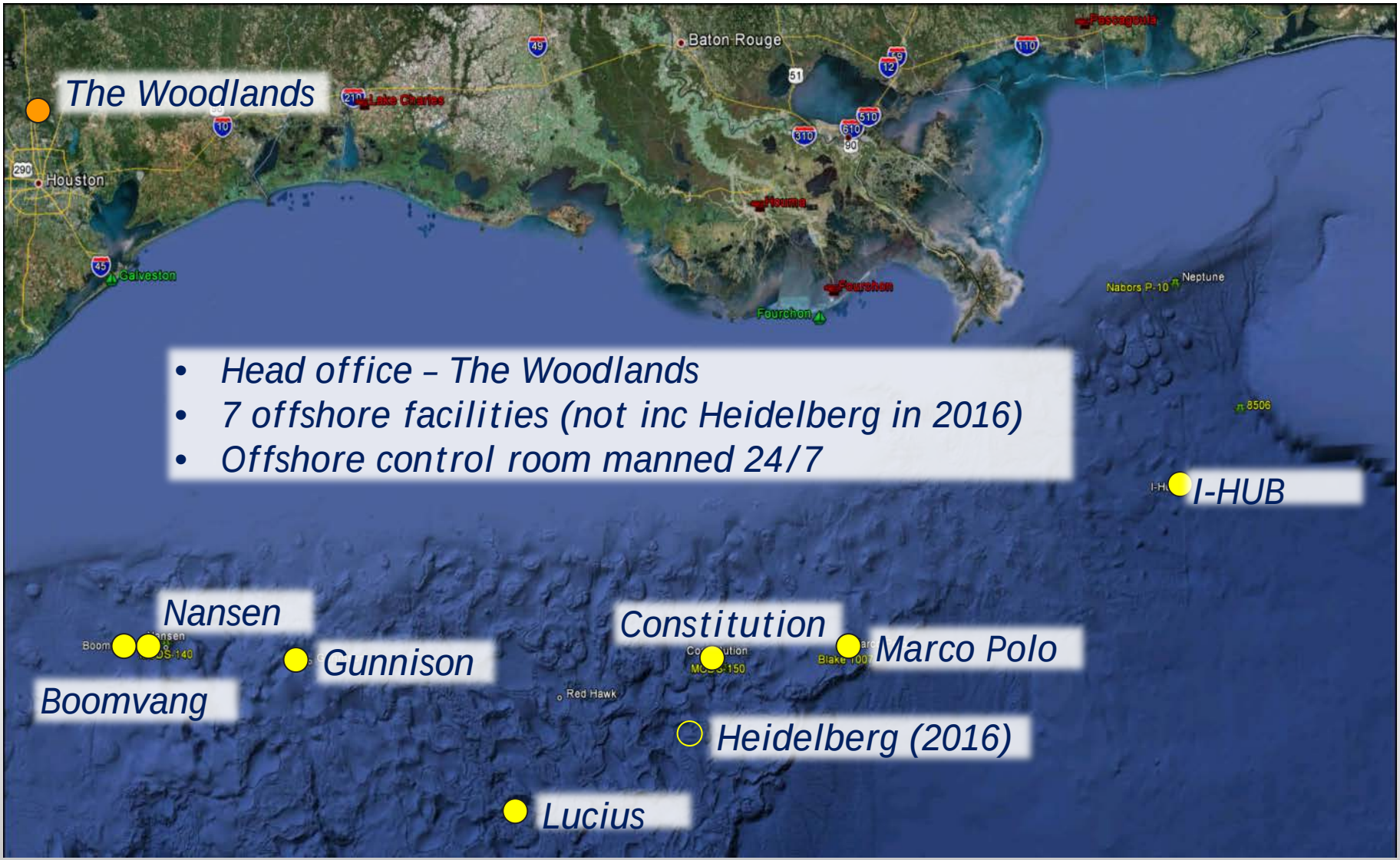
“Real Time” Monitoring Production Operations

(Amro Hamza)

Agenda

- Anadarko GOM Operations Overview
- Reply to BSEE Questions
- Summary

GOM Facilities



- *Head office – The Woodlands*
- *7 offshore facilities (not inc Heidelberg in 2016)*
- *Offshore control room manned 24/7*

Q1 - Does your company use real-time monitoring for its offshore operations? If not, why?

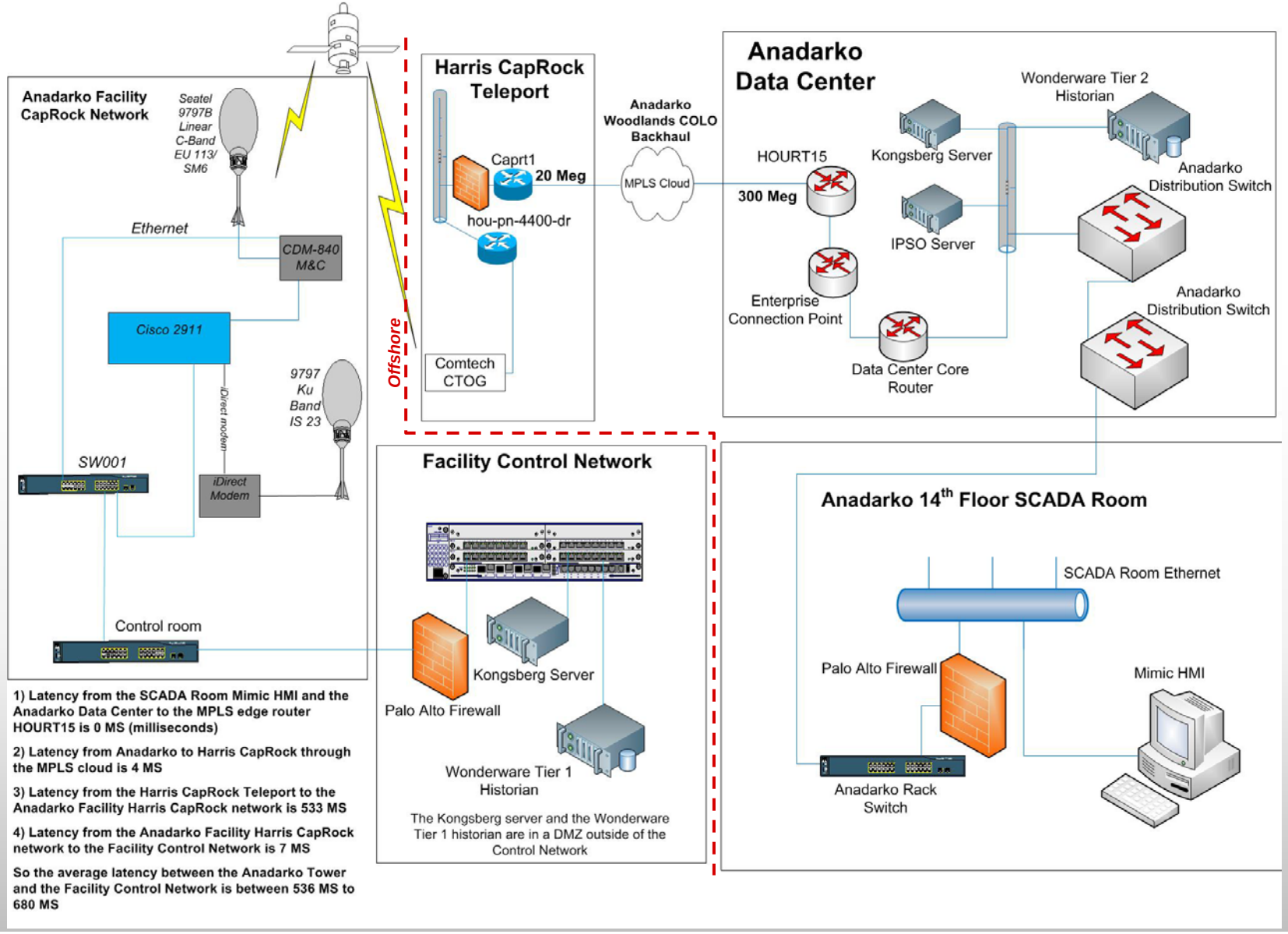
- If your company does use real-time monitoring, what are the critical operations and specific parameters that your company monitors?
- Are there specific criteria or risk thresholds that your company uses to prompt real-time monitoring requirements (e.g. factors such as well or water depth, frontier area, HP/HT wells, or well complexity)?

- If RTM – staffed 24/7 by experienced personnel?...No
- All our offshore facilities are staffed and control room manned 24/7.
- Accountability needs to reside offshore.
- Limited visibility of offshore activity from onshore.
- Anadarko limits maintenance activity to daytime.
- Facilities are designed to fail safe.

Operations Monitoring Room

- Wonderware InTouch Remote HMI Applications
  - Operations Monitoring Room – The Woodlands
  - Room is NOT staffed continuously
  - Web based connection also available

Anadarko Control Network Monitoring and Data Transfer



1) Latency from the SCADA Room Mimic HMI and the Anadarko Data Center to the MPLS edge router HOURT15 is 0 MS (milliseconds)

2) Latency from Anadarko to Harris CapRock through the MPLS cloud is 4 MS

3) Latency from the Harris CapRock Teleport to the Anadarko Facility Harris CapRock network is 533 MS

4) Latency from the Anadarko Facility Harris CapRock network to the Facility Control Network is 7 MS

So the average latency between the Anadarko Tower and the Facility Control Network is between 536 MS to 680 MS

Operations Real Time Monitoring

- Wonderware InTouch Remote HMI Applications
  - *Typically utilized by Production Engineers*
    - Operational issues and well start up
    - Hydrate and chemical injection issues
    - Well unloading, plugging issues
    - Support discussions between office and field on rates, temperatures, pressures
      - Engineers in office view the same HMI information as the field personnel
  - *Other Uses*
    - Technical Services Group
      - Rotating Equipment
      - Vessels
    - Facilities Engineering Group
      - Mooring System
      - Void Leak Detection System

- **Q2 - Does your company rely on any automation and predictive software in real-time monitoring?**
  - Automation and safety system separate
  - Most safety switches are now analog, allowing visibility of operating conditions
  - Predictive software only used for maintenance activity (condition based maintenance/monitoring).
- **Q3 - Condition-based monitoring is viewed by BSEE as monitoring the operating condition of critical equipment and using any generated data to predict and proactively intervene when needed.**
  - As such, what role could condition-based monitoring play in real-time monitoring?
  - Describe how operating equipment using condition-based monitoring could be tailored and/or used for real-time monitoring.

Production Operations Real Time Monitoring

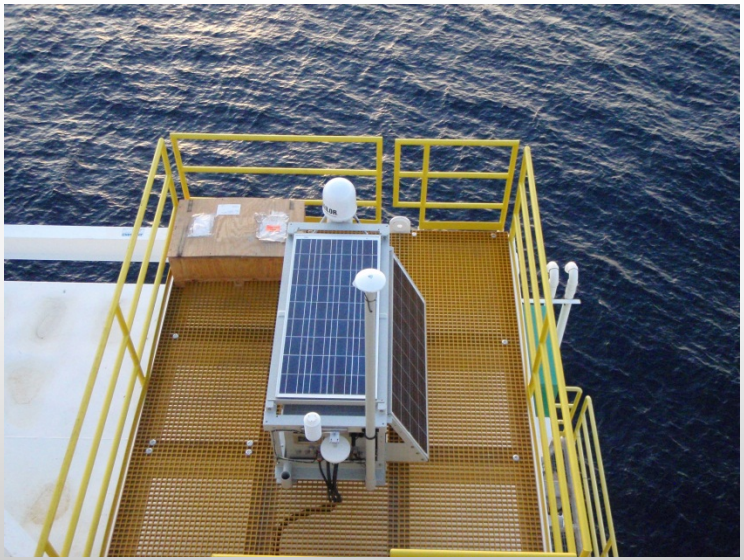
- Caterpillar InSight Remote Monitoring and Diagnostics
  - ***Monitors Solar Turbine Compressor & Generator Packages***
    - Turbine Packages are monitored remotely by Solar Turbines in San Diego, CA
    - Parameters and triggers are monitored to provide advanced diagnostics, condition monitoring, and predictive recommendations
    - In House and Remote Solar Representatives can access the equipment and data to assist field personnel with diagnostics and repairs
    - Operations maintenance personnel can also access reports and technical data via a web portal

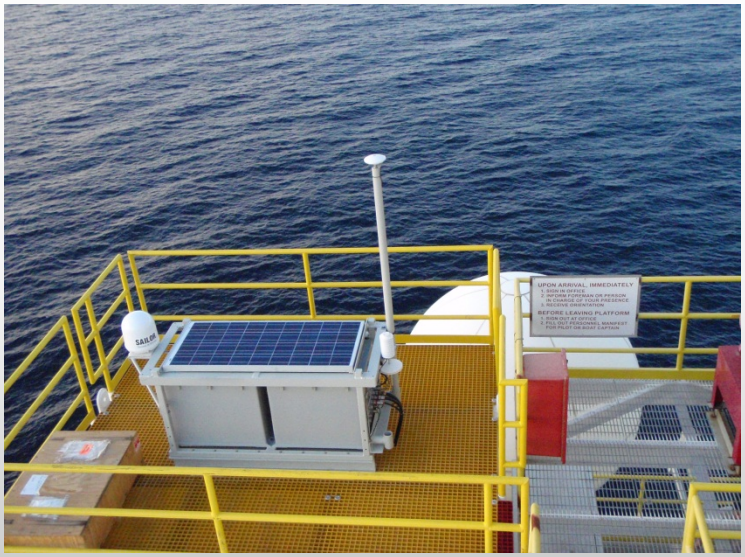
- BMT Independent Remote Monitoring System (IRMS)
  - ***Provides key data related to environmental and physical conditions of the facility while unmanned during a storm event***
    - Deepwater facilities are rendered "invisible" to onshore monitoring due to need to power down and secure satellite systems
      - IRMS system allows ability to check status and stability of facility
      - Provides data to analyze need for support vessels and equipment
      - Provides data to confirm safe wind speeds and visual confirmation of helipad conditions
      - GPS data can be analyzed to determine offset of facility due to mooring failure or changes in draft

Production Operations Real Time Monitoring

IRMS System

- Totally self-contained, self powered, stand-alone remote monitoring system that requires no support or services from the facility during hurricane operation
- Integrated stabilized satellite communication system independent of any company network or communications services
- Allows monitoring of environmental conditions and facility motions remotely via the internet
- Focus of usage is the period prior to, during, and immediately after a hurricane event



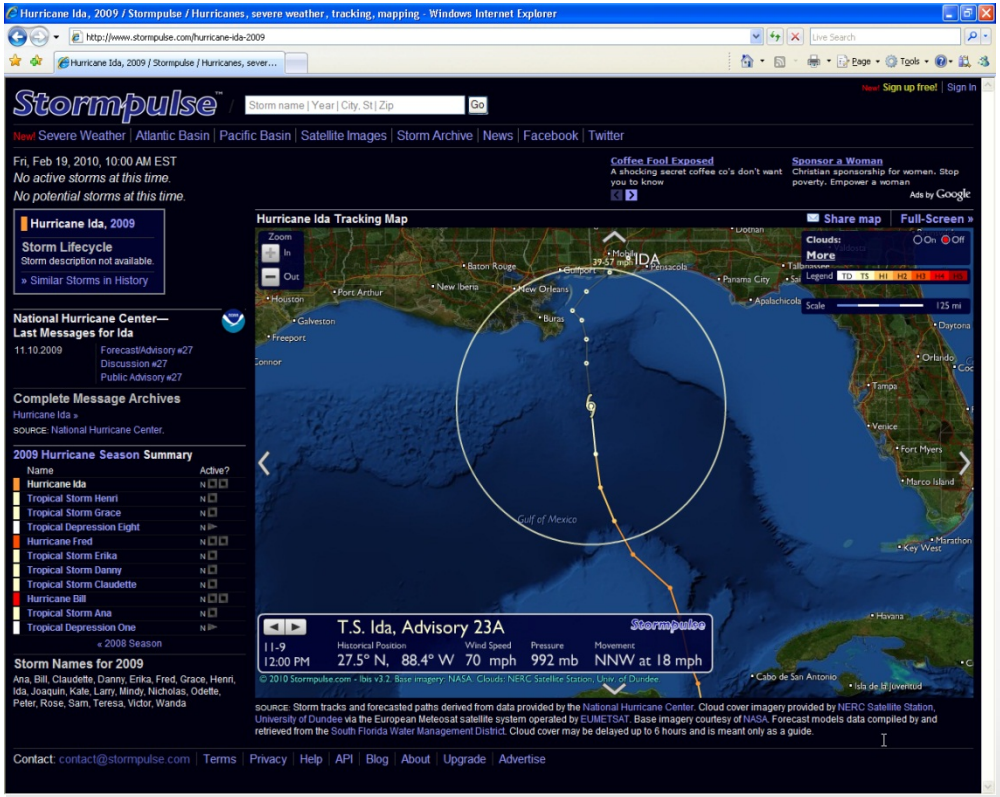


Production Operations Real Time Monitoring

- IRMS System
  - Parameters
    - Platform motions and responses (6DOF)
    - Wind, Temperature, Barometric Pressure
    - GPS data
    - Video and Pictures

Production Operations Real Time Monitoring

IRMS System TS IDA 11/9/2009 Advisory



STA IRM 11/09/09 13:00:00				
Time: 11/09/09 13:00:00 to 11/09/09 13:20:00				
CHANNEL NAME	**UNITS**	**MAX**	**MIN**	**MEAN**
Roll Rate	deg/s	0.429043	-0.492965	-0.047164
Pitch Rate	deg/s	0.725254	-0.667203	0.015282
Yaw Rate	deg/s	0.492758	-0.40891	-0.020308
Surge Acc	ft/s^2	1.670101	-1.61319	0.078173
Sway Acc	ft/s^2	1.33048	-1.442942	-0.157029
Heave Acc	ft/s^2	33.584199	30.665024	32.120298
Barometric Pressure	**mbars**	**994.8**	**991.5**	**993.381579**
Air Temperature	**degF**	**79.772**	**77.99**	**78.908698**
Humidity	%	0	0	0
Wind Rel Direction	deg	132	87	113.801834
Wind Speed RAW	knots	65.313158	37.12742	51.252106
GPS Quality	#	2	2	2
Input Voltage	Volts	14.7	14.4	14.57414
Input Current	Amps	4.8	2.4	3.07214
Battery Voltage	Volts	13.4	13.2	13.299979
Output Current	Amps	5	2.5	3.215607
Battery Temperature	degC	23	22	22.67785
Charge State	Code#	2	2	2
List	deg	-0.247757	-0.294006	-0.272231
Trim	deg	-0.108364	-0.166747	-0.138725
GPS Latitude	deg	28.085132	28.085075	28.085104
GPS Longitude	deg	-87.985775	-87.985846	-87.985799
Platform Northings	ft	44.068607	23.221244	33.857849
Platform Eastings	ft	31.475392	8.744958	23.552016
Platform Offset	ft	49.170594	33.843005	41.625005
Altitude	ft	134.511155	115.291667	122.388142
Wind Speed	**knots**	**65.313158**	**37.12742**	**51.252106**
Wind Direction	**degT**	**132**	**87**	**113.801834**
North Wind Speed	knots	2.339857	-37.462089	-20.741928
East Wind Speed	knots	58.973706	34.099723	46.499621
1min 10m Wind Speed	knots	62.716183	50.101024	56.848378
Roll	**deg**	**0.804771**	**-1.628877**	**-0.259717**
Pitch	**deg**	**1.611458**	**-1.64067**	**-0.148767**
Tilt	deg	2.23576	0.002597	0.559346
Tilt Dir	degT	359.916467	0.015811	224.978145
Static Tilt	deg	0.31966	0.29253	0.306091
Static Tilt Dir	degT	248.771924	236.78722	242.957939

- **Q4 - BSEE would like to use real-time monitoring technologies to accomplish many of its safety and environmental protection responsibilities.**
  - Real-time monitoring technologies could be incorporated into BSEE's existing safety and environmental regulations in order to replace or supplement its on-site inspection program.
    - *Can not replace and opportunities to supplement inspection program from onshore are very limited.*
  - How could BSEE leverage such technologies?
  - Which activities could real-time monitoring supplement or replace?
  - What opportunities do you see for BSEE to use real-time monitoring to provide timely, functional, and value added inspections?
  - What would you recommend that BSEE do in the real-time monitoring area?
    - *RTM for production operations is an operational tool to help support offshore staff. Using RTM as an oversight tool does not add any value except to give people a false sense of security.*

Summary

RTM

- Production facilities are designed to fail SAFE.
- Anadarko does not have staffed onshore RTM centers for Production Operations.
- Offshore facilities are shut-in prior to hurricane evacuations.
- RTM (i.e. IRMS) used to monitor environmental conditions around the facility.
- Ultimate control resides with OIM (Offshore Installation Manager).
- Mimic stations are available onshore and are used by support staff for troubleshooting and support NOT oversight.

Condition Based Monitoring

- RTM for condition based monitoring only for large rotating equipment to improve uptime and minimize maintenance costs.
- Example of other condition based monitoring activity (non-RTM);
  - *Flow assurance modeling*
  - *Mechanical integrity program*
  - *IR (infra red) inspection*