Real Time Monitoring Overview – Deepwater Rig Operations

National Academy of Sciences

Real Time Monitoring of Offshore Oil & Gas Operations

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LLOG Exploration Company

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LLOG Real Time Monitoring Q&A 1-2

Target Questions:

1. Does your company use real-time monitoring for its offshore operations? - **YES**

2. If your company does use real-time monitoring, what are the critical operations and specific parameters that your company monitors?

For clarity LLOG's answers refer to monitoring beyond the monitoring/supervision provided by the onsite LLOG Drilling and/or Completion Foreman.

Drilling – All activities, exploratory and development with "mudloggers" on site to provide real time monitoring service/advice/guidance to the LLOG Drilling & Completion Foreman.

Completion – some "mud-logging support" on critical completions – where critical is defined by the complexity of the completion and the need to fully understand downhole parameters – more of a mechanical efficiency measure where we employ downhole surveillance MWD or real time monitoring equipment. On all Frac Jobs and Well Tests (flow-backs) we employ full offsite real time monitoring of all job parameters.

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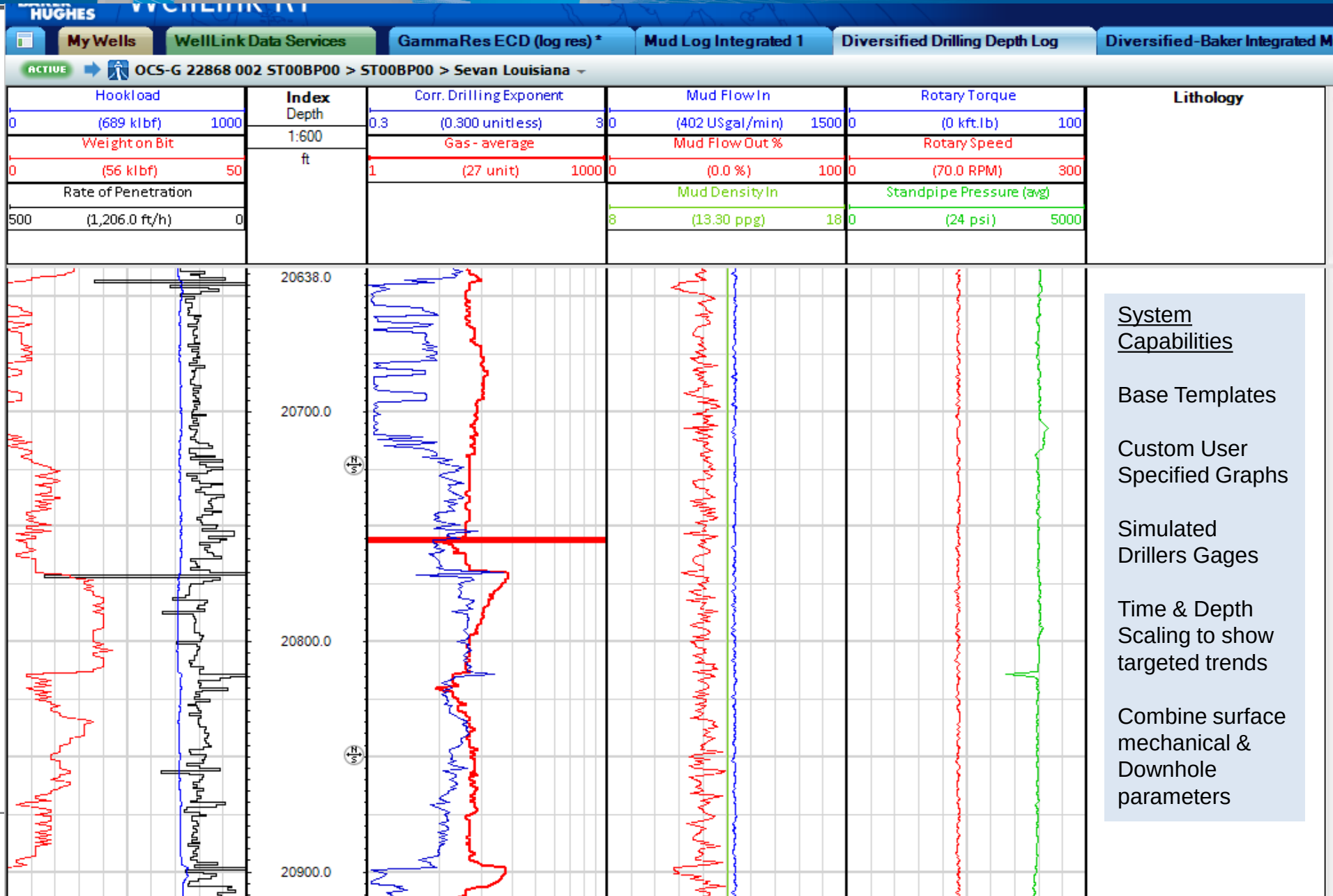
3. Do you believe there are specific types of wells or operations and parameters (for drilling, completions or work-overs, or production operations) that always should be monitored with real-time monitoring? YES – for drilling exploration wells or development wells where the pore pressure and fracture gradient trends are not well understood – real time monitoring (either onsite or offsite) of the pore pressure trends and updating of pore pressure predictions should be in place and is in place at LLOG.
4. 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)? No – we ensure real time monitoring capability is in place for all of our drilling operations, exploration and development.

5. Does your company rely on any automation and predictive software in real-time monitoring? In the well operations – the drilling contractor uses high and low level alarms for critical drilling parameters. As the operator LLOG uses real time pore pressure monitoring to ensure we are looking ahead of the bit to ensure proper mud weights are used. We do not automate our pore pressure predictions, since there is a critical lithological interpretive protocol that can not be automated.

Real Time Drilling Mechanical Data – Example Data



System Capabilities

Base Templates

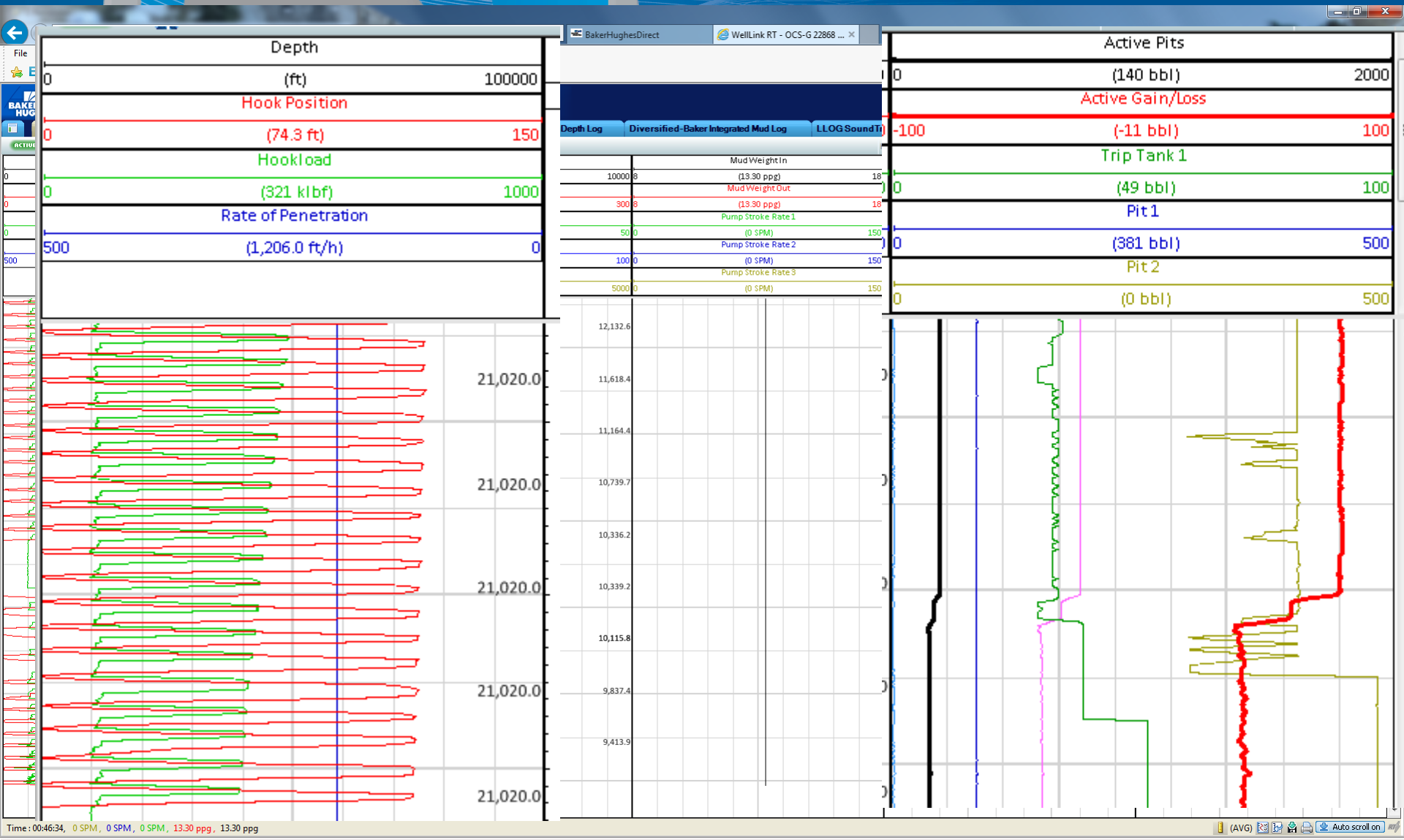
Custom User Specified Graphs

Simulated Drillers Gages

Time & Depth Scaling to show targeted trends

Combine surface mechanical & Downhole parameters

Real Time Drilling Mechanical Data – Example Time Data



parameters

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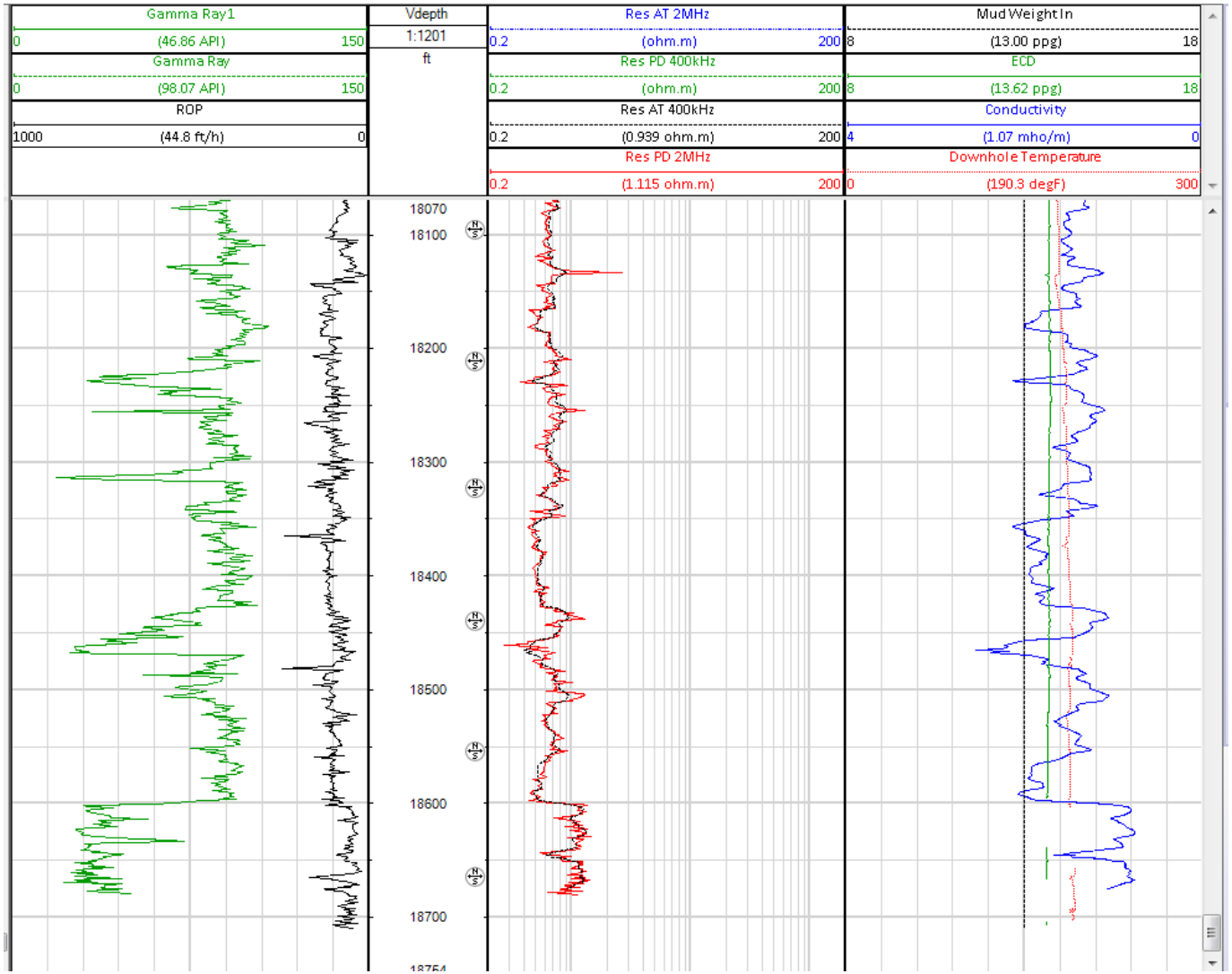
Real Time Drilling Downhole Data – Example Depth Data



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6. What role could automation and predictive software tools play in real-time monitoring?

   Limited at best. Well operations are not conducted in a controlled factory or plant setting. Our operations are conducted in a downhole operating environment where many parameters are estimated and are only known within a range of assumed values. To "automatically" trigger alarms or even corrective actions based on assumed downhole conditions is likely to result in excessive false alarms – eliminating confidence in the system – or in the case of limited alarms , over reliance on the system and missed warning signs when downhole parameters are encountered outside the predictive model assumptions.

7. 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?

   From an equipment standpoint (Subsea BOP, Riser, & and Surface parameters) – real time monitoring by tying into the Drilling Contractor's data gathering system could add value, **if** the monitoring of such systems were consistent and responsive. Due to the connection to the downhole conditions LLOG supports proactive notifications based on the "data stream" but would strongly oppose any type of offsite control.

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8. Describe how operating equipment using condition-based monitoring could be tailored and/or used for real-time monitoring.

- Since the equipment is owned and maintained by the drilling contractor, any condition based monitoring would have to interface with the drilling contractors data management system. Real time use of this data for intervention decision making would have to meet the Drilling Contractor and OEM data QA/QC as well as work with in the Drilling Contractors SEMS program. Any actual intervention protocol would have to be approved by the Operator via the Operator and Drilling Contractor SEMS bridging documents.

9. BSEE would like to use real-time monitoring technologies to accomplish many of its safety and environmental protection responsibilities. Realtime monitoring technologies could be incorporated into BSEE's existing safety and environmental regulations in order to replace or supplement its on-site inspection program. How could BSEE leverage such technologies?

- The use of real time monitoring data to replace an on-site inspection program should be rejected. Data quality, reliability and interpretation challenges are too great to allow RTM to serve as a replacement for an onsite inspection program.

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10. Which activities could real-time monitoring supplement or replace?
    Replace – none. Supplement – BOP pressure tests once the data sampling, and recording methodologies are standardized and proven to enable onshore monitoring of Subsea BOIP testing.

11. What opportunities do you see for BSEE to use real-time monitoring to provide timely, functional, and value added inspections?
    See answer above. A properly archived RTM data stream could enhance BSEE onsite Inspections and incident investigations by providing a common data set to BSEE, the Operator and Contractor.

12. What would you recommend that BSEE do in the real-time monitoring area?
    BSEE should require a performance based RTM standard for Operators to demonstrate the use of real time monitoring capability to enable safe operations. The standard should not require a fixed structure/building/office to house the real time monitoring capability but require the operator to document how the data stream is (a) accessed real time, (b) archived and (c) accessed for use by the operator and contractors on a real time and post event basis to enable safe operations.

Questions?