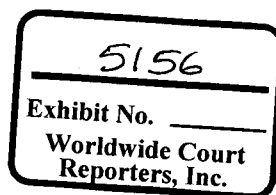

Cameron Summit Meeting Action Item Report

Interim and progress Report on reliability
issues related to Cameron BOP Control
Systems.

By: Hiltbold /
Gray/AC

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Confidential



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Executive Summary

The current purpose of this report is to communicate the known deficiencies with the company's affected Subsea Engineers, Engineers, Rig Managers, and new build support personnel in order to solicit their input on any additional reliability matter with respect to Cameron Controls which should be addressed at a corporate level. The intent is to identify, prioritize, evaluate, and implement reliability improvements.

The designation "Action Item 2 – Reliability Issues" originates from a series of Summit Meeting between the management of TSF and Cameron. The effort to improve the reliability of the Cameron MUX system on TSF's ten affected rigs was deemed to be critical to both companies. This report covers issues identified by Cameron and TSF. Not all reliability issues have been identified. It is the intent of TSF to uncover all deficiencies and make informed decisions on how each reliability issue will be mitigated. Over the coming weeks there will be increased effort to identify the remaining issues.

Action Item 2 – Reliability Issues

ACTION #2

After the rigs are successfully on hire, the longer-term objective of the task force assembled for Action #1 is to make recommendations for improving reliability on other rig classes and future new builds. It is expected that these recommendations would be available by mid-June 2001. During this time, the task force would report progress on a weekly basis to key personnel in TSF and Cameron, to be defined to the task force by each company.

Update

The task groups effort to date has been to identify known problems and mitigate the potential for failure. The team has not made recommendations for future new-builds. Reliability issues have been considered in two groups, Drill Through Equipment, and BOP Controls. This report is isolated to BOP Control System Equipment. This report groups the action items necessary to consider an issue "closed" under each subheading. A check mark indicates an action is closed vs. a box that indicates open actions. The status of implementing the various actions necessary to improve reliability are reported under Implementation Status.

BOP Control System Equipment

- 1. Sub-sea Electronic Modules (SEM) Overheating :** Overheating of SEM electronic components has been experienced while the BOP stack is on the deck which caused the failure of a board in the power supply. This problem does not exist when the BOP is sub-sea due to the heat transfer with the sea water. Even though overheating while the BOP stack is on the surface may not result in an immediate
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failure in the SEM, the long term effect on the electronic components could lead to premature failure of the SEM in the future.

- ☒ Cameron has issued their Product Advisory 1816038 which explains the problem and their recommended solution, which is to install a new board, and fan in the SEM's to circulate the air which results in a significant reduction in the air temperature.
- ☒ TSF shall review, approve, and provide direction to its applicable rigs based on Cameron's Product Advisory.

2. Special Operating Procedures / O & M Manuals: Some customers have complained that the Operating and Maintenance Manuals provided by Cameron do not fully meet their needs. As part of the original capital equipment order the Enterprise will receive trouble shooting and diagnostic information for the BOP control system in addition to what is normally supplied with the equipment manuals.

- ☐ TSF shall evaluate the additional trouble shooting and diagnostic information supplied for the Enterprise to determine if it is a valuable tool and if it is something that should be ordered for other Cameron MUX rigs. TSF will request that Cameron put on a demonstration to assist us in our evaluation. (Status - TSF has not received the CD or Manuals.)
- ☐ Cameron will issue a New Product Release, NPR, and budgetary quote.
- ☐ Based upon the results of the evaluation, TSF shall prepare a recommendation regarding the value in acquiring additional diagnostic trouble shooting tools.

3. Cameron 1/2" Unbalanced Shuttle Valves: Failures of the unbalanced shuttle valve to shift have been reported in water depths of more than 3,200' and 2,500 psi operating pressure. Cameron's investigation revealed that there was no compensation fluid inside the compensation bladder when the valve was originally installed. Cameron has issued Product Advisory 1820038, which explains the problem in detail and includes their recommended solution, which is to fill the bladder with grease that will be supplied by Cameron at no cost when requested. The Cameron PA also includes the part numbers of the affected valves and affected assemblies as well as the part number for the grease.

- ☒ TSF shall review, approve, and provide direction to its applicable rigs based on Cameron's Product Advisory.

4. Cameron 1-1/2" Pilot Operated Check Valves: An unusual number of washed and damaged seals have been experienced and downtime occurred on at least one customer's rig. Cameron has upgraded seal kits available to resolve the problems. (Cameron supposedly replaced this valve on the Cajun and Express. The Cajun just experienced a failure of this valve. The failure is under review.)

- ☒ Cameron replaced valves p/n 307488-12 with p/n 2185178-02 stab mounted and p/n 307488-22 with p/n 2185178-01 w/ 1-1/2" NPT inlet and outlets on Cajun Express & Sedco Express.

- ☐ Cameron has released the new part numbers, but TSF has requested that they issue a formal PA which explains the improvements for distribution to the affected rigs.
- ☐ TSF to make all affected rigs aware of the problem and the new part numbers, and then to distribute the Cameron Engineering Development Notice to the rigs once it has been issued. (Status – TSF rigs have been alerted. Currently waiting on Cameron's official notice.)

5. A) Cameron Surface Flow Meters: Original Cameron supplied surface flow meters are subject to damage in certain high flow situations. Damaged flow meter internal parts could potentially damage BOP control system components downstream of the flow meter if they are not caught by an in line filter. TSF rigs have experienced several failures of Cameron flow meters. (According to Charlie Hill in TSF North Sea operation Cameron has issued three part numbers for the turbine type flow meter not two.) Both subsea flow meters have failed on Cajun.

- ☐ Cameron has advised that high-shock and ultrasonic flow meters are available as replacements for the original flow meters. Cameron to issue a New Product Release Notice (NPR) recommending the change in flow meters. The NPR will identify the obsolete part and its replacement.
- ☐ Cameron will provide a quote for the new model shock resistant flow meter.
- ☐ TSF will review the advisory and issue a directive to its fleet.

B) Cameron Sub-sea Flow Meters: Original Cameron supplied sub-sea flow meters have proved to be unreliable. The blades have come off.

- ☐ Cameron has advised that high-shock is available as replacement for the original flow meters. Cameron to issue a New Product Release Notice (NPR) recommending the change in flow meters. The NPR will identify the obsolete part and its replacement.
- ☐ TSF shall review the Cameron advisory and quote and provide instruction to its affected rigs.
- ☐ TSF will review the advisory and issue a directive to its fleet.

6. Event Logger Software: Cameron engineering has developed and released new event logger software version 7.5 which is compatible with all its MUX control hardware. The revision standardizes the software across all the Cameron control systems. Additional features will also be offered by Cameron.

- ☒ Cameron to confirm that all rigs are using version 7.5 software,
- ☐ Cameron shall produce a data sheet for the event logger for additional features as optional equipment. Cameron shall issue New Product Release Notices as new add on features are made available.
- ☐ TSF shall verify 7.5 version is installed.

- ☐ TSF shall review, approve, and provide direction to its applicable rigs based on documentation provided by Cameron.

7. Cameron Float Type Accumulators: The float in Cameron's float style sub-sea accumulators will sink when used in water depths greater than 3,000' where Nitrogen is being used as the pre-charge gas.

- ☒ Cameron has issued Safety Alert 1820078 which describes the problem and provides an explanation for the float sinking phenomenon. Based on field performance and mathematical calculations, Cameron recommends that Helium be used as the pre-charge gas for float type accumulators in water depths in excess of 3,000' and the system operating pressure is 5,000 psi.
- ☒ TSF shall review, approve, and provide direction to its applicable rigs based on Cameron's Safety Alert.

8. Cameron Solenoid Valves: Cameron original supplied solenoid valves have experienced some sticking problems due to high friction forces between the seal ring and seal plate. When a solenoid sticks the function fails.

Note : Recently the Energy's Super Shear rams failed to close during an EDS incident because the High Pressure solenoid valve was stuck. The solenoid had the new seats and solenoid. The valve was also not being routinely functioned. The Enterprise is also reporting sticking solenoid valves on a VBR and Annular function

- ☒ Cameron has included a chemical coating application to the 440C seal plates and have improved their polishing method to reduce frictional forces. The seat is treated by a nitriding process. Cameron states all TSF rigs have the improved seats.
- ☐ Cameron should issue an advisory stating the improved seal plates with policy/coating and part number change.
- ☒ In addition to changing the seats Cameron modified the solenoid coils in order to provide a higher pull in force.
- ☐ Cameron shall verify all software upgrades have been made to the affected TSF rigs which are required for the new solenoids. Note the old coils also work with the new software. The new solenoids are referred to as - 61 vs. - 15.
- ☐ Cameron will issue a NPR which describes the improved - 61 solenoids.
- ☐ Using the NPR, TSF shall verify the status of the solenoid change out process.

9. Cameron Hot Line Issue : N/A. This appears on the list as a result of a third party inspection company statement that hotlines were required to operate deepwater MUX BOP's.

- ☒ No action required.

10. Cameron Ceramic Seal Plates for 1/4" Valves : A bad batch of ceramic seal plates has resulted in some failures in 1/4" directional control valves. It appears ceramic seal plates suffer from infant mortality. One the valve with new seats is past the infant mortality the valve seems to be reliable according to Cameron. They state the majority of failures occurred during FAT.

- ☒ Cameron has issued Engineering Bulletin 861-C which explains the problem. It also advises that Cameron is migrating to the use of AISI 440-C material for these valves, but they can also supply repair kits with ceramic seal plates depending upon customer preference. Cameron's EB gives part numbers for both ceramic and 440-C repair kits.
- ☒ TSF shall review the bulletin and determine which material should be used and notify its rigs accordingly. Currently both seal plates are being used on TSF rigs.

11. Continuous Connector Latch Pressure: Cameron Collet Connectors are sometimes difficult to unlatch. Cameron has issued various notices on the connectors which address maintenance, operation, testing and controls. One such notice was issued by the Cameron Controls Group. Cameron has two recommended options for controlling the connector. These recommendations should be reconciled with other Cameron notices and TSF's field experience.

- ☒ Cameron has issued Engineering Bulletin 687, which explains their two recommended options for keeping latch pressure on model HC Collet connectors used on wellheads. Apparently the LMRP connector is not addressed by Cameron.
- ☐ TSF to review the two options recommended for each rig with Cameron HC collet connectors and provide direction to its fleet.
- ☐ Express class rigs control systems were designed by Cameron, but do not include either of the Cameron recommended options. This situation needs to be reviewed with Cameron and a decision made on the controls set-up. (The decision can not be made until the collet connector and control system is studied.)

12a. Cathodic Protection on Mark II Pods: The original design did not have enough cathodic protection on the pod frames. Mark II pods are on the Enterprise, Horizon, and Nautilus.

- ☐ Cameron has supplied revised drawings and BOM's for each of the affected rigs.
- ☐ TSF shall issue and advisory and confirm that all anodes are installed in accordance with the drawings. (Steve Hiltbold has the drawing)

12b. Cathodic Protection on Mark I Stainless Steel Pods:

- ☐ Cameron has completed calculations to determine requirements for cathodic protection. Results to be distributed to TSF thru a series of advisories that will cover TSF's affected class of rigs. (Status – Express Class is near completion. It is TSF's understanding Cody Moffit has the information)
- ☐ TSF to review results of Cameron calculations after they have been distributed and issue direction to its affected rigs.

13. BOP Control System Fluid Cleanliness: Customers have requested BOP fluid specifications from Cameron.

- ☒ Cameron has issued two documents to customers : Water Based Hydraulic Fluids Purchaser's Guide and Water Based Hydraulic Fluids User's Guide.
- ☐ TSF has made the documents, Water Based Hydraulic Fluid User's Guide, X-201679-01 and Water Based Hydraulic Fluid Purchaser's Guide, X-201678-01 available through TSF Docs and has recently redistributed them. (Todd Gray is to distribute)

14. Needle Valves : The seat material for four Cameron supplied needle valves has been changed. The original seat material is obsolete and replaced by a new part. These needle valves are only used in surface systems and are not known to cause downtime.

- ☒ Cameron has advised TSF part numbers of affected valves.
- ☒ TSF has informed its rigs of the new part number.
- ☐ In order to document closure of the action, TSF shall issue an O & M Advisory. (Steve Hiltbold will issue the advisory.)

15. Seawater Ingress into BOP Control Systems: Cameron has identified that sea water can enter the control hydraulics through the ROV port when standard shuttle valves are used. Cameron is making available a new pressure biased shuttle valves.

- ☐ Cameron has carried out a design review of the affected systems, and the new drawings are in the hands of the Cameron after market personnel. Cameron shall issue an NPR or other notice to Transocean.
- ☐ TSF to review the new Cameron drawings and documentation once it is in hand and provide direction to its rigs. TSF Engineering shall review and approve the use of the pressure biased valve before its introduction. (It appears the valve is made by Gilmore and is likely suitable.)

16. Cameron 1" Tandem Pod Valves : O-ring extrusion in the seal rings was the cause of a number of 1" pod directional control valve failures and sticking valves. The extrusion is caused by using too soft an O-ring in certain applications.

- ☒ Cameron's investigation revealed that a batch of valves with O-rings with a shore hardness lower than that specified in the BOM's made it into some pods. Cameron has issued Product Advisory 22060 that explains the problem in more detail and gives the correct BOM's for the valves and repair kits for each affected rig.
- ☒ The Cameron PA has been transmitted to all affected TSF rigs.
- ☐ TSF to approve the advisory and place it on TSF Docs. TSF to take steps to insure that repair kits in stock with incorrect part numbers are not used.

17. Cameron Accumulator Float Sinking : Under certain control system pressures and flow rates, it is possible that freezing or hydrates could be present at the floats in the accumulators. This could occur when using either helium or nitrogen.

- ☒ Cameron has completed a series of tests to try to determine exactly what causes this problem, but the results are inconclusive
- ☐ TSF should develop a policy regarding the use of sub-sea float type accumulators. One rig uses float accumulators subsea, and several may be using float accumulators on surface.

18. Gilmore Mark I / II / III Shuttle Valves: Field problems with the Gilmore Mark I and Mark II shuttle valves prompted the Mark III design.

- ☒ The Gilmore Mark I and Mark II shuttle valves were supplied with a number of Cameron MUX BOP control systems. Under certain high flow conditions, shuttle valve failures were reported due to O-ring extrusion and some shuttle fractures. Subsequently, Gilmore developed the Mark III shuttle valve to overcome the deficiencies of the earlier models. Cameron has issued Product Advisory 1602 to address this issue.
- ☒ TSF, reviewed the advisory and stated its position to its affected rigs. TSF also issue an ALERT earlier in the year. TSF intends to move away from the Mark II and III valve. (Gilmore is developing a new version of the shuttle valve and testing is taking place each day. TSF is actively involved in the design review and testing aspects of the new valve.)

19. Connector Unlatch Protection : An LMRP connector was inadvertently unlatched from a BOP control panel.

- ☒ Cameron has issued Product Advisory 18020 to address this problem. It shows a recommended LMRP and wellhead connector function lockout arrangement that complies with current MMS requirements.
- ☒ This PA has been distributed to all TSF rigs on the list. TSF to insure that all rigs implement a similar lockout on their control panels. TSF will issue its position on the advisory.

20. Heat in BOP Control Panels: There is some concern that heat buildup in some BOP control panels may be excessive.

Some operators have reported that BOP control panels feel hot to the touch although no malfunctions have been attributed to the heat. Cameron has performed calculations for each of the rigs.

- ☐ Cameron shall provide TSF with the part numbers of the kits and the affected rigs in order for TSF to issue an Advisory.
- ☐ TSF shall issue an Advisory that explains: Cameron says they have sent panel heat test kits to all TSF rigs. Personnel on the rigs should use these kits if there are any panels that seem excessively warm, and the results should be communicated back to Cameron engineering for review. Steve Hiltbold shall prepare a TSF advisory in order to clearly communicate the necessary actions on each rig.

21. Cylinder Nut Failures: A failure of a nut on an extend cylinder in a pod was reported to Cameron and the competitors rig suffered downtime.

- ☒ Cameron's analysis revealed that the failure was due to environmentally assisted cracking. Cameron has issued Product Advisory 20060, which explains the problem in more detail. Cameron is supplying replacement nuts for all affected rigs.
- ☒ TSF will issue its position on the advisory and provide direction to its rigs.

21.A Cylinder Nut Failures: A failure of tie rods on two rig's extend cylinders in a pod was reported to Cameron and the one TSF rig failed but avoided down time.

- ☐ Cameron has now identified that the tie rods are also affected by environmentally assisted cracking. Product Advisory to be written or 20060 to be revised.
- ☐ TSF will issue its position on the advisory and provide direction to its rigs.

22. HPU Relief Valves: Relief valves on some BOP control systems may be undersized which could result in pump pressures higher than originally designed.

- ☒ Cameron has replacement relief valves along with piping modification kits for each of the affected rigs. They have issued Product Advisory 20200, which explains the problem in more detail and lists the affected rigs and original and new drawing numbers and BOM's.
- ☒ TSF will issue its position on the advisory and provide direction to its rigs.

23. PBOF Cables: Several BOP control systems have reported concerns over seawater ingress into the systems through the cables. Several TSF have suffered downtime when the PBOF suffered from water ingress.

- ☒ Cameron has just recently completed some testing on the PBOF cables in England. Cameron has released the results of the testing in Engineering Development Notice CS-001750-02.
- ☐ Cameron shall issue an NPR
- ☐ A quote to replace the Enterprise's PBOF cables shall be provided.
- ☐ TSF to review the notice and quote and make appropriate recommendations to the rigs.

24. Dead Man Battery Life: Questions have been raised regarding the expected life of the batteries for the dead man systems.

- ☒ Cameron has released Engineering Report ER 2768 which contains the results of their testing of dead man battery packs to determine how many actuations can be obtained under certain environmental conditions.
- ☐ TSF to review the engineering report and establish recommended interval for battery change out for the affected rigs. TSF shall provide direction to its rigs. (Todd Gray will draft the TSF advisory)

25. Shear Pin for ODI FITA Connectors: The shear pin for these connectors is too strong and does not break away at the required load to protect the connector termination.

- ☐ Cameron has designed a new shear pin and is conducting testing at ODI to qualify the design. Cameron shall issue advisory when a replacement shear pin is available.
- ☐ TSF will issue its position on the advisory and provide direction to its rigs.
- ☒ TSF has issued an ALERT # to its rigs on MUX connectors which also addresses shear pins.

26. Diverter Packer Circuits: There exists the potential for excessive noise, vibration, and Diverter packer circuit wear caused by a height difference between the Diverter packer and the HPU. The only reported problem on a TSF rig occurred on the Enterprise during commissioning.

- ☒ Cameron has issued Engineering Bulletin EB 869 C, which gives a detailed recommended course of action to resolve the problem.
- ☐ The Engineering Bulletin has been distributed to all rigs. TSF to review the engineering bulletin and insure that affected rigs are provided with direction. Todd will review the Cameron bulletin, discuss the Enterprise event with Pat Rogan, and then draft a TSF advisory.

27. Diverter Packer Relief Valve Setting : On the Energy, the Diverter operating system has a maximum working pressure of 3,000 psi, but the Diverter control system is limited to 1,000 psi.

- ☐ TSF and Cameron to review Diverter operating system parameters given to Cameron for control system design.
- ☐ Cameron to recommend control system modifications. May require a PO from TSF if Diverter system information originally given to Cameron was incorrect.
- ☐ TSF to review the Cameron recommendations and advise the Energy accordingly. Todd Gray will issue an advisory based on Cajun event. He will also find out what the other rigs have done.

28. BOP Control Panels: Drillers and tool pushers control panels on the Energy are losing communications when the systems are powered down and then powered back up.

- ☐ Cameron to provide TSF with a procedure for power down and power up situations for control systems. Steve Hiltbold shall work with Margaret Buckley at Cameron to resolve this issue.
- ☐ TSF to review the Cameron recommendations and then distribute to the rigs.

29. BOP control system memory: There is not enough memory installed in the Energy's BOP control system.

- ☐ Steve Hiltbold will find out from Iain Hope what the status is on the memory upgrade.
- ☐ Cameron has advised that memory shortage is due to additions and changes to the original control system design. Memory upgrades may be purchased as required.
- ☐ TSF to review memory requirements with Cameron and develop an appropriate plan of action.

30. System pressure loss: The Energy experienced temporary loss of control of the sub-sea regulators.

- ☐ One theory for loss of control is that two people were trying to adjust the regulators from the two remote control panels at the same time.
- ☐ TSF has requested that Cameron carry out a study to evaluate what should happen if both remote panels are operated simultaneously. (Steve Hiltbold will ask Iain Hope to perform this test on the Energy. And to find out if this is still a concern.)

31. STM Purge ports: Some components have 1/4" or 1/2" NPT purge ports that cannot be tested.

- ☐ Cameron has modified porting from NPT to a custom double O-ring design. This can be ordered through Cameron customer service. Cameron should provide a drawing of the housing and what is affected.

- ☐ TSF to review which rigs require the modified porting and advise rigs accordingly through the TSF Advisory.

32. Pressure & Temperature Transmitters: The pressure transmitters provided with the Horizon, Energy, and Enterprise were only rated to maximum BOP working pressure. They should be rated for BOP working pressure plus hydrostatic head.

- ☐ Cameron should provide upgraded pressure transmitters for the affected rigs. Cameron should issue an advisory stating which rigs are affected and the action items. According to Paul Toudouze Cameron will provide the pressure Transducers as a warranty item.
- ☐ TSF to install the new pressure transmitters once they have been received.

33. Mixing System: MMS Regulations require that the BOP fluid systems be able to supply mixed fluid at a rate faster than the pumps rated output.

- ☐ Cameron to review the design of the mixing systems of the affected rigs and to provide details and parts required to meet the regulatory requirements. Cameron will issue an advisory.
- ☐ TSF to review the revised Cameron design and implement the changes on the affected rigs. TSF shall issue an Advisory.

34. Direct Control Valves: The Horizon experienced interflow problems when started cold especially under low flow conditions using the hot line

- ☐ This problem was specific for a valve on the Horizon. The seals in the valve were changed, and Cameron was not able to reproduce the problem in their shop. Steve Hiltbold will discuss this issue with the Horizon and find out if there is an action item or not.

35. OLM Fault: An OLM fault (loose connection) resulted in numerous alarms.

- ☐ This problem was specific to the Horizon. Cameron requires additional information in order to evaluate the problem and determine a solution. Steve Hiltbold will discuss with Steve Donohue and find out if there is an action item. They will also determine if anything should be included in the Cameron MUX Training course.
- ☐ TSF to provide additional information as requested by Cameron.

36. Valve seal plates and seal rings: Corrosion rates in sub-sea valves and regulators is unacceptable using existing materials. The Enterprise suffered subsea downtime as a result of corrosion to the 440c seal plates in the regulators and directional control valves. Another drilling contractor suffered similar downtime. In order to mitigate the corrosion TSF instructed its rigs to flush the pods when the BOP is retrieved.

- ☐ Cameron has developed a new line of valves that uses premium materials that offer improved corrosion resistance. Cameron is to provide their information to TSF for review. Cameron shall provide an NPR and quote for various valves.

- ☐ TSF to review the information provided by Cameron and issue a TSF Advisory.

37. Solenoid valve cables and pie connectors: Solenoid faults have been experienced which have been attributed to the solenoid valves and pie cables.

- ☐ Cameron has made a revision to the solenoid cables in early 2000. This revision is intended to be offered as an upgrade as requested per rig. Cameron shall issue an NPR and quote.
- ☐ TSF to review the information on the new cables and issue an Advisory.

