

Form CC1 ATLANTIS MoC REQUEST - CHANGE REQUEST

Initiator: Ryan Malone	Date: 09-07-2007	Change Request No.: SS-06-013 Rev3
Responsible Managers: Gene Hall		Project Team: Atlantis Subsea
Title of MoC Request: Atlantis Overall Subsea Phase 1 (SS1) MOC		
Reason for the MoC Request (<i>*Attach continuation sheets or additional documentation as needed</i>):		
<p>In response to the Thunder Horse DC-41 manifold incident, the Atlantis Project Team has proactively taken precautions to avoid a similar incident within the Atlantis subsea system design. The lessons learned from Thunder Horse, via the Manifold Investigation Team (MIT), have identified risks associated with 8630/625 material interface, and Atlantis has developed the Subsea Phase 1 (SS1) concept which eliminates all of the 8630/625 material interfaces in production equipment. All 8630/625 material interfaces have been removed from all Atlantis Subsea equipment, with the exception of the Water Injection PLET which will be the subject of a separate MOC and decision process.</p> <p>Plans for Atlantis SS1 include the reconstruction of Atlantis Manifolds that will be a temporary design. The SS1, 3 header, valve-less manifolds will be replaced within the 5 year safe operating life of the manifold. SS1 also includes reconstructed, valve-less Pipeline End Terminations (PLETs) that have a 25 year design life.</p> <p>New build SS1 PLEMs contain reconstructed 9" gate valves and are landed at Drill Center 1 (DC 1) on newly installed 36" casing piles. Each of the 4 SS1 PLEMs (PT, PP, PP1, PP2/3) have varying safe operating lives which will be discussed in further detail below. PLEM PP2/3 has a safe operating life of 25 years, and PLEMs PT, PP and PP1 have a safe operating life of 3 years. The safe operating life of PLEM PP and PP1 can potentially be extended to 25 years if the Project implements a number of measures to protect against and mitigate under-deposit corrosion within the PLEMs. The Project is currently evaluating methods of implementation of these preventative and mitigating measures for PLEM PP and PP1.</p> <p>The SS1 concept, including the reconstruction of the manifolds and PLETs, and the new build PLEMs, is a departure from the Atlantis sanction case design. Likewise, the SS1 concept, which specifies that manifolds and certain PLEMs will be replaced within 5 and 3 years respectively, is a departure from typical industry practice.</p> <p>Atlantis SS1 equipment will be replaced with permanent Subsea Phase 2 (SS2) equipment within the previously determined safe operating life of the individual SS1 equipment. The safe operating life of each piece of equipment was the subject of intense study by a multi-discipline technical group, and the results of the study can be found within the Decision Support Papers (DSP's) and Management of Change (MOC) documents referenced in attachments to this MOC.</p> <p>** The execution of this MOC (MOC SS-06-013 Rev3: <i>Atlantis Overall Subsea Phase 1 (SS1) MOC</i>), as well as the execution of the following MOC's immediately referenced below, will be contingent upon the completion of an SS1 equipment piping and structural design review and approval by Rod McFarlane, BP Technical Authority for Pressure Vessels and Piping.</p> <ul style="list-style-type: none"> • MOC SS-07-016 Rev0: <i>Atlantis SS1 PLEM Design & Construction</i> • MOC SS-06-012 Rev5: <i>Atlantis SS1 Manifolds Reconstruction</i> • MOC SS-06-009 Rev3: <i>Atlantis SS1 PLET's Reconstruction</i> 		
HSSE Change Review Required? No <input type="checkbox"/> Yes <input checked="" type="checkbox"/> (<i>*If yes, which controlled or frozen documents changed</i>)		
<p>An externally facilitated HAZOP was conducted on November 07th-09th, 2006 to review the changes of the SS1 design as compared to the original base case design. The HAZOP Report can be viewed by accessing BP Document Number 1440-33-SB-PR-0129: <i>Atlantis Subsea Phase 1 (SS1) HAZOP – Draft Report</i>.</p> <p>Rod McFarlane has performed a detailed review of the SS1 equipment piping and structural design (referenced in the section above), and has provided his endorsement of the SS1 design on August 30th, 2007.</p> <p>Likewise, a SS1 Peer Review was held on September 12th-14th in Houston, Texas. Another SS1 Peer Review was held on April 11th-13th in Houston, Texas, and the Final SS1 Peer Review close-out took place on June 26th in Houston, Texas. Each of the mentioned Peer Reviews was facilitated by David Brookes, BP Subsea Chief Engineer. The Peer Review reports are referenced in the attachments to this MOC.</p>		

Describe the MoC Request and Impact on Existing Systems*:

The reconstructed Atlantis Manifolds, PLETs and new-build PLEMs are designed to eliminate the direct metallurgy combination associated with the Thunder Horse DC41 manifold failure and to mitigate the risks of internal corrosion. Some aspects of the original manifold operability design have been preserved; however, there have been changes that will affect the overall operability of the manifold and subsea system. The primary requirement that will not be retained is the ability to switch the well to manifold header alignment. This means that each of the Atlantis wells will flow through a pre-determined flowline and riser, and all wells will be able to flow through the test line. Additionally, the ability to implement double isolation without impacting production will be reduced.

The SS1 manifolds will have 3 main headers instead of the 4 headers in the original design and the SS1 manifolds will have no valves to allow wells to produce into different flowlines. This has the potential to impact production and flow assurance optimization. The lack of valves in the SS1 manifold design has the potential to increase operations downtime due to the fact that parts of the subsea system might have to be shut-down to allow new well tie-ins to flush hydrocarbons from the 6" branch headers of the SS1 manifold. These impacts are well understood and accepted by the Project Team.

The SS1 system and individual components are designed to pass a pig (i.e. used 3-D bends, and maintained consistent use of nominal pipe size) but the system is incomplete with respect to round trip pigging paths. As a result, the SS1 pigging plan, including infrastructure requirements for round trip pigging, will be the subject of a separate MOC.

As previously mentioned, the SS1 manifold will be a 3-header design utilizing the previous manifold frames and majority of clad piping. All 21 (qty) of the 6" gate valves in the original design have been removed. The reconstructed manifolds will consist of partially-clad main headers, branch headers, and connections. A clad-to-unclad transition insert will be used to connect the manifold to the manifold hubs. Carbon steel welds will be applied at the connection of the unclad end of the transition insert and the hub, with all other welds being clad-to-clad. All 8630/625 buttered welds have been removed from the reconstructed manifold, PLET and new-build PLEM design.

The replacement of temporary SS1 components with Subsea Phase 2 (SS2) permanent subsea equipment is linked to the Atlantis asset Long-Term Plan (LTP), and the capital and expense associated with the re-build and re-installation is included in a supplemental Financial Memorandum (FM) that will be brought to the Resource Commitment Meeting (RCM) for funding approval in 2007.

The subsea safe operating life of the SS1 manifolds is 5 years. The safe operating life of the PLETs is 25 years. PLEM PP2/3 has a safe operating life of 25 years, and PLEM PT, PP and PP1 have a safe operating life of 3 years. The safe operating life of PLEM PP and PP1 can potentially be extended to 25 years if the Project implements a number of measures to protect against and mitigate under-deposit corrosion within the PLEM. The Project is currently evaluating methods of implementation of these preventative and mitigating measures for PLEM PP and PP1. Atlantis SS1 equipment will be replaced with permanent components within the safe operating life of each component.

The operating lives identified above require the following key items to ensure safe operations:

- A maximum corrosion rate of 2 mils/yr is required to achieve the designed 25 year safe operating life for the Atlantis flowlines and risers (minimum corrosion allowance = 0.12"). This corrosion rate can be obtained with a chemical availability of 95% and an inhibitor effectiveness of 97%. If this level of inhibition is achieved, then the corrosion allowances associated with the manifolds, PLEMs and PLETs are more than sufficient to cover their 3 - 25 year operating lives. The maximum corrosion rates for the PLEMs (minimum corrosion allowance = 0.323") and PLETs (minimum corrosion allowance = 0.238") which have 25 year safe operating lives are 14 mils/yr and 13 mils/yr, respectively. The corrosion inhibitor is formulated to mitigate bacterial growth and galvanic corrosion as well as general corrosion.
- In order to ensure effective inhibition, sand and other debris will need to be periodically removed from any unclad horizontal piping which has a planned safe operating life of 25 years. Note that the 3 yr PLEM design lives (PP, PP1 and PT) assume under deposit corrosion is occurring because of un-piggable dead legs. In addition, the SS1 manifolds do not require the removal of deposits because all the horizontal piping is clad.
- Production chemistry assumptions will need to be checked periodically to determine if the corrosivity of the produced fluid has changed and cumulative wall loss will need to be estimated and tracked for the entire system. Information from the corrosion coupons and monitors located on the topsides should be integrated into this evaluation.
- The water level in the manifolds under normal flowing and shut in conditions should not come in contact with the dead leg portions of the manifolds that remain unclad (piping below the 6" and 10" jumper hubs).

The subsea integrity management program will need to include a surveillance and monitoring program and pigging and / or flushing program to ensure that these requirements are met. Further, it is anticipated that unclad long term pressure caps will be recovered during new well tie-ins during the SS1 manifolds design life. This equipment, and other unclad equipment recovered, must have non-destructive test (NDT) inspections performed to confirm that corrosion rates are not higher than anticipated.

No other activities are required to confirm the safe operating lives of the SS1 equipment. However, opportunities do remain to provide additional monitoring and possibly optimize operating lives by using smart pigging technology and NDT inspection tools packaged for subsea use.

Affected Project Team(s) / Delivery System(s) / Discipline(s): (*Note: All affected parties must initial approval of this change.*)

<input checked="" type="checkbox"/> Subsurface	<input type="checkbox"/> Floating Systems	Disciplines:	Other:
<input checked="" type="checkbox"/> Wells Drilling	<input checked="" type="checkbox"/> Subsea	<input type="checkbox"/> Mechanical	<input type="checkbox"/> Electrical
<input type="checkbox"/> Wells Completion	<input checked="" type="checkbox"/> HSE&R	<input type="checkbox"/> Structural	<input type="checkbox"/> Instruments
<input checked="" type="checkbox"/> Topsides	<input checked="" type="checkbox"/> Operations	<input type="checkbox"/> Piping	<input type="checkbox"/> Estimating
<input type="checkbox"/> Integration	<input checked="" type="checkbox"/> Regulatory	<input type="checkbox"/> Process	<input type="checkbox"/> Procurement
		<input type="checkbox"/> HVAC	<input type="checkbox"/> Commissioning

CAPEX Impact (Labor/Non-Labor):	\$36.6MM	Start Date:	
		End Date:	
OPEX Impact:	\$82.7MM		
Net Schedule Impact: (+/-):	Weeks: +10		
Net Weight & COG Impact:	Tons: 0	x (ft)=	Y(ft)= z(ft)=

Technical & Economic Evaluation*:

The lessons learned from Thunder Horse DC-41 manifold system failure as well as subsea design fundamentals led the Atlantis Project Team to develop options for the reconstruction of PLETs and manifolds, as well as the construction of new-build PLEM.

A list of support documentation detailing the selection criteria and decision making process for the design, fabrication and installation of these subsea components is attached to this MOC. Also attached to this MOC, are lists detailing the revision and completion status of all Operations and Project and Engineering documentation that have been affected by the implementation of SS1.

Schedule impact was the primary reason that the valve-less manifold design, the reconstructed and valve-less PLET design and the new build PLEM design were recommended by the Atlantis Project Team. The complexity of qualifying appropriate weld procedures and material sourcing issues for the construction of permanent subsea equipment would have made it impractical for the Project to meet a first oil date in 2007.

Please refer to the individual Decision Support Packages for the decision criteria and technical and economic evaluation for each of the individual subsea components.

HSE&R Impact*:

The change in manifold design eliminates 8630/625 buttered welds. Without the change, an incident similar to Thunder Horse's DC-41 manifold failure could have potentially occurred, with the potential of leaking hydrocarbons into the Gulf of Mexico. This would impact the environment and BP's reputation.

Removing the valves from the original design means that Operating procedures will need to be put in place in order to flush the 6" branch headers, to further reduce the risk of hydrocarbon discharge, prior to future well tie-ins. Methods of flushing hydrocarbon from the 6" branch headers of the manifold have been tested in a full scale mock-up of the SS1 manifold at low pressures using clear plastic piping. A branch header flushing report and procedures have been generated, approved by Operations, and both are referenced in the list of documentation attached to this MOC.

The safe operating life of each component has been determined and accepted without the need for corrosion monitoring during the safe operating life of the equipment. However, the asset team will be working to develop options for future monitoring that may assist in the management of the SS1 kit.

Specifics of the corrosion mitigation and monitoring activities are covered within documents referenced in the list of documents attached to this MOC.

HSE Change Review Complete and Signed Off?
 Comments / Recommendation *:

No | Yes

Responsible Manager's Recommendation:
 Change Request Approval Signature(s):

<i>Reject</i>	<input type="checkbox"/>	<i>Approve</i>	<input checked="" type="checkbox"/>
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Printed Name: Gene Hall <i>Approval Signature:</i>	Atlantis Subsea Delivery Manager (BP)
Printed Name: Rick Oneto <i>Approval Signature:</i>	Atlantis Operations Manger (BP)
Printed Name: Dean Rayburn <i>Approval Signature:</i>	Atlantis HSSE Manager (BP)
Printed Name: Jonathan Sprague <i>Approval Signature:</i>	Atlantis Wells Delivery Manager (BP)
Printed Name: Pramod Singh <i>Approval Signature:</i>	Atlantis Subsurface Manager (BP)
Printed Name: Dennis Sustala <i>Approval Signature:</i>	Atlantis Regulatory Compliance Manager (BP)
Printed Name: Donnie Carter <i>Approval Signature:</i>	Atlantis Engineering Authority (BP)
Printed Name: Rob Marshall <i>Approval Signature:</i>	GoM SPU Engineering Authority (BP)
Printed Name: Gary Imm <i>Approval Signature:</i>	Atlantis Deputy Project Manager (BP)
Printed Name: Simon Todd <i>Approval Signature:</i>	Atlantis Deputy Performance Unit Leader (BP)
Printed Name: Greg S. Sills <i>Approval Signature:</i>	Atlantis Performance Unit Leader (BP)
<i>When completed forward the MoC Coordinator for logging and distribution.</i>	

Atlantis Subsea Document Matrix (In preparation for First Oil)						
Document Name / Description	BP Doc. Number	Rev.	Responsible	Date Due	Status	Comments
1 Atlantis SS1 MOC	MOC-SS-06-013	2	Ryan Malone		Pending	Issued for approval 6/15/2007
2 Atlantis SS1 PLET Re-construction	MOC-SS-06-009		Ryan Malone	3/6/2007	Complete	
Decision Support Package: Atlantis Subsea Phase 1 - PLET Selection	1440-33-SB-PR-0098	6	Ryan Malone	2/22/2007	Complete	
Corrosion Mitigation Study: Alternative Subsea PLET Options	1440-33-SB-PR-0106	0	Connie Bargas	1/19/2007	Complete	
Materials & Welding Design Book: Subsea Phase 1 (SS1) Pressure Piping Arrangements, Weld Maps, & Materials Layouts	1440-34-PL-DSP-0224	0	Bob Evans	10/27/2006	Complete	
3 Atlantis SS1 Manifolds Re-construction	MOC-SS-06-012	5	Ryan Malone		Pending	Issued for approval 6/10/2007
Decision Support Package: Atlantis Subsea Phase 1 - Manifold Selection	1440-33-SB-PR-0104	2	Ryan Malone	4/25/2007	Complete	
Corrosion Mitigation Study: Alternative Subsea Manifold Options	1440-33-SB-PR-0116	0	Connie Bargas	4/7/2007	Complete	
Materials & Welding Design Book: Subsea Phase 1 (SS1) Pressure Piping Arrangements, Weld Maps, & Materials Layouts	1440-33-MN-DSP-0092	0	Bob Evans	12/12/2006	Complete	
4 Atlantis SS1 PLEM Design & Construction	MOC-SS-07-016	0	Ryan Malone	5/28/2007	Complete	
Corrosion Assessment: SS1 PLEM Design	1440-33-SB-PR-0119	3	Connie Bargas	4/19/2007	Complete	
Materials & Welding Design Book: Subsea Phase 1 (SS1) Pressure Piping Arrangements, Weld Maps, & Materials Layouts	1440-34-PL-DSP-0263	0	Richard Lau	4/25/2007	Complete	
5 ATL SS1 MOC Support					Pending	
Subsea Operations Procedures Updates			Ron Berger		Pending	
SS1 Documentation Tracking			Peter Chan		Pending	
Statement of Requirements	1440-10-AS-DC-0001	C	Connie Bargas	7/2/2007	Complete	
6 Manifold Pushing Test Results						
Executive Summary	1440-33-MN-RP-0130	0	Richard Lau	7/23/2007	Complete	
Documentation of Approval from Operations	N/A		Richard Lau		Complete	
Compilation of Daily Testing Reports	N/A		Richard Lau		Complete	

Revision

12-Jun-2007

PeriBACKUP 13-4pr

-> ASSURANCE REVIEW STATUS

Doc #	Title	First Oil	Phase MOC	REV	SS Ops Reviewed	SSOP ER	HSE Ops		HSE Design		FA ER		Mustang ER		Ops Interface		PQ ER		BH ER		
							Required	Reviewed	Required	Reviewed	Required	Reviewed	Required	Reviewed	Required	Reviewed	Required	Reviewed	Required	Reviewed	
1440-25-OP-PR-3028	Well Data - steady	Y	Y	0																	
1440-25-OP-PR-3031	Well Data - steady	Y	Y	0																	
1440-25-OP-PR-3032	Well Data - steady	Y	Y	0																	
1440-25-OP-PR-3028	Reference	Y	Y	B																	
1440-25-OP-PR-3028	Reference	Y	Y	F																	
1440-25-OP-PR-3024	Pigging - Production Water		Y	C								X			X						
1440-25-OP-PR-3025	Pigging - Water Injection		Y	C								X			X						
1440-25-OP-PR-3035	Production Water		Y	C								X			X						
1440-25-OP-PR-3035	Production Water		Y	nb								X			X						

- Procedure in development / pending modification.

- Pending review of procedure

- Review of procedure COMPLETED

- Pending pre-requisite review (e.g. MER)

- Post first oil

- Not a detailed procedure, requires Safe Work Plan at time of job

- Rough Draft available, not ready for review

- No Draft started

- Submitted for review 8-Jan-2007

- On Hold