Task 1

System Presentation

The system of this subsea manufacturing is being acknowledged as the wells on the floor of the sea as resistant to the superficial. The well has been drilled by a rig (which is movable) and rather than constructing a platform of manufacturing for that well, the natural gas, as well as oil (which is extracted), are conveyed by riser or by pipeline (undersea) to another manufacturing platform (nearby). This has permitted the subsystem manufacturing platform for giving service to various wells over a fairly big area (Ivanova and Shabalov, 2021). This subsea manufacturing system is typically in utilization at the depth of near about 7000 ft. The piece of equipment which is selected to identify the faults within it is the **production raisers**. This component is the section of the flowline within the sub-system that is positioned between the host facility and the bed of sea which is adjacently placed to that host facility. However, when it comes to the dimension part, it can be stated that in diameter the component is 12 inches or 304.8 mm wide. The length of the component has been presented by the depth of the water as well as the configuration of the riser.

Functions Of The Component

The selected component has dual pipes and obtains a diameter scale range from 5 to 32 inches. However, when it comes to the functionality of this component then it can be stated that the production risers of this system give the means for the natural gas as well as cruise oil for flowing to the wellhead of the ocean floor on the superficial of the platform. This annulus within the dual pipes will act as a means for dissimilar flowlines, lines of chemical injection, devices of wireline services, and wires of electrical instruments for entering the well in an effective way (Yasseri et al. 2018). The rise pipes have been built up within this system in sections up to the length of 60 ft with the necessary linkers at every single end and are developed for withstanding natural disasters such as hurricanes, typhoons and many more.

Failure Modes And The Impacts Of The Components

Erosion can be stated as one of the most considerable failure modes of production risers of this system. The erosion of the "**Internal polymer sheath**" or carcass portion of this component generally takes palace at the time when the particles of sand provide an effective impact against dissimilar materials present throughout the system. This mode of failure is pertinent to the sections of the pipe that are curved. This failure mode becomes more significant at the time when production risers become more general, as the velocities of the flow in that place tend to be greater (Yue et al. 2021). Conventionally within this component of this system, a limit in velocity (which is equal to 20 m/s) has been specified. However, the foundation of this is undefined. Another failure mode that can be considered in this case would be the collapse because of external pressure.

Integrity And Technical Risk

The integrity management on the basis of the subsea production system has been considered to be dominating the oil and natural gas exploration with respect to the resources found in the deep water. It has also been dealing with the failure associated with this SPS that has been leading towards the enormous loss of economy, environmental pollution, as well as some other casualties. The safety, as well as the reliability of the SPSs, has been becoming a major concern in the present times (Beskhizhko, 2021). The investment should be made for monitoring and inspection of the SPS in order to guarantee great integrity for the prevention of failures with respect to the subsea equipment. The present technological progress has been taken into consideration that has been using some non-destructive testing within the SPSs. There are some basic principles as well as the features based on the NDT techniques that have been further used for the IMSPSs reviews.

Task 2

Reliability Analysis

Reliability investigation and testing are the two main section of the assurance of reliability and neither one of them single-handedly provide assurance to the deliverables of the system reliability. As for the reliability assurance of this subsea manufacturing system, it can be stated that the investigation of various codes and guidances will lead to the development and as they have addressed "New Technology" (Tabella et al. 2020). This term has indicated the equipment that utilizes a physical regulation for making a performance for a specific function. Both the equipment and the physics of it need to be qualified. In which the equipment of the subsea system is a version (which is marinized) of topside equipment, any type of new physics hardly is engaged. Then it becomes the equipment they need qualification.

Key Processes Establishing Reliability Assurance Of The Subsea System

As per the above figure, it can be explained that there are 8 major processes for giving an environment (which is supportive) for accomplishing reliability via customizing a suitable phase of reliability over the lifecycle of this subsea system. This figure has indicated that Testing and reliability qualification is an assessment of technical risk (which is systemic) and approach of risk management which involves:

Presentation of technical requirements

Acknowledgement of failure modes as well as mechanisms of technology (Smirnov and Kharchenko, 2021).

Evaluation of failure is crucially for assessing actions (that are relevant) taken to decrease the uncertainties as well as risk.

Testing to elaborate functional performance

“**Technology Readiness Level (TRL)**” for highlighting the extent to which a segment is prepared for utilization.

FMECA

FMECA indicates 3 dissimilar aspects which can be considered for the analysis approach of this subsea system. These aspects are “**a) Failure mode, b) Effects, c) Critical analysis**", in addition, it has been seen that an FMECA is normally conducted for auditing reliability as well as the criticality of sole aspects (which are independent) of the selected plan of action of maintenance and is frequently the first phase within a study of system reliability. However, to recognize the causes behind failure and the modes of failure, as well as their impacts on various assemblies, subsystems and sole aspects possible, are reviewed (Wang et al. 2019). The major findings will be enlisted within a worksheet. Another course of action for making identification of hazards or events (that are undesired) is "**hazard and operability study (HAZOP)**" or the identification of hazard which can be acknowledged as HAZID. Moreover, the criticalities or priorities of FMECA are assigned for the effects of failure mode. It is, for the most part, a qualitative investigation that needs to be implemented or to be executed during the phase of the design of the system. That is fo0r making an identification of the areas that have the requirement for the development in order to accomplish the requirements of the reliability. The FMECA of this subsea production system is as follows:

	Non-operational	**Operational**	**Environmental**	**Safety**	**Hidden consequences**		
Severity level	**4**	Death	Not applicable	Not applicable	High	High	High
		>$100000	Minor	Major	High	Not applicable	Not applicable
	3	Incapacitated	Not applicable	Not applicable	High	High	High
		$10000 to $ 100000	Minor	Major	Major	Not applicable	Not applicable

	2	Slight injury	Not applicable	Not applicable	Major	Major	Major
		$1000 to $10000	Not applicable	Minor	Minor	Not applicable	Not applicable
	1	No injury	Not applicable	Not applicable	Insignificant	Minor	Minor
		<$1000	Not applicable	Insignificant	Insignificant	Not applicable	Not applicable

Occurrence		
Ranking	**Effect**	**Failure rates**
10	Extremely high	> 1 in 2
9	Very high	1 in 3
8	Very high	1 in 8
7	High	1 in 20

6	Marginal	1 in 100
5	Marginal	1 in 400
4	Unlikely	1 in 2000
3	Low	1 in 15000
2	Very low	1 in 150000
1	Remote	< 1 in 1500000

Detection			
Opportunity for detection	**Rank**	**Detection likelihood**	**Detection opportunity**
No detection of errors	10	Almost impossible	No opportunity for detection
Not likely for detecting risk at any phase	9	Very remote	Not likely for detecting risk at any phase,
Post design for subsea management	8, 7, 6	Remote, very low, low	post-processing for problem decisions, Issue detection at origin,

Prior to designing subsea management	5, 4, 3	Moderate, moderately high, high	post-processing of error detection
Virtual analysis of measurement system	2	Very high	Error detection
Failure prevention, leading to detection	1	Almost certain	Detection not applicable

Table 1: FMECA of the subsea manufacturing system

RPN of the system

According to the above tables, it can be stated that the RPN of this system will be = Severe * Occurrence * detection = 3 * 4 * 6 = 72.

Task 3

Measurement System Design

As for the requirement of the subsea management system, it can be stated that the necessary implementation for measurement device for subsea manufacturing system can be an advancement which will possibly sess via a pipeline or a container for tracking the fingerprint of the chemical (liquid, gas or solid) of substances as well as processes transformation within their composition in real-time. The possible measurement system in this scenario will be a sonic gauge which will be an ultrasonic advancement(which is non-invasive) and the main activity of this measurement system will be to measure (in a simultaneous) more than one property of a material flowing via the pipeline of this system. It will be designed in a way that the process of this measurement system will use ultrasound (which is dispersive), measurement process (which is non-linear) and the characteristics of algorithms for evaluating the quality of the product (in a precise manner), on-line and in real-time (Srivastav et al. 2021). This measurement system will transmit the pressure, vibration and temperature of the wellbore (in a wireless manner) in real-time. This will be a mandatory device for this subsea manufacturing system as it deals with the storage of subsurface energy and gas wells and oil. This measurement system (wireless downhole) will be suitable for giving real-time data of the downhole at the time of manufacturing, observation, and injection of the good operation. There is no depth in the restriction for the system of data (which are wireless) acquisition the site stations of Sonicrepeater can be utilized for giving a thrust to the data packets (that are acoustic) to surface.

Moreover, sensors will be developed within this measurement system and these wireless sensors and the stations of Sonicrepeater can be conducted by the high expansion gauge hanger. The main activities with which the system will be engaged with: a) Energy storage observation (underground), b) reservoir monitoring, c) failed replacement of PDHG, d) Lift (which is artificial) monitoring, e) Manufacturing testing of well, f) "**Drill Stem Testing**", g) Barrier as well as P&A verification. As for the observation of energy storage, the acoustic data of this measurement system will permit the regulatory (which is cost-effective) by giving a high resolution as well as high accuracy to the downhole gauge (wireless) for measuring the trends of pressure in order to recognize the tiniest deviation from the pressure of subsurface storage (which are expected). In addition, this measurement system will give a dynamic calculation of injection as well as manufacturing gradients of pressure when the stations of Sonicrepeater will be obtained with the transducers of pressures (onboard) will be implemented at strategic places along the string of tubing (Li et al. 2020). However, when it comes to the implementation of observation activity of reservoir it can be stated that this measuring system will utilize the acoustic data to provide reliable as well as simple real-time information reporting and also acquisition as an exchangeable option to both "**permanent downhole gauges (PDHG)**" (which is cabled) or the surveys of memory (which is infrequent) memory. The advancement can be implemented permanently on the clamps or can be ported subs on the external portion of tubing at the time of the compilation of the well. Moreover, there will be another way that indicates the fact that it can be redeveloped in an internal way of the manufacturing tubing on the "**high expansion gauge hanger**" through the sick line.

As for the installation system of this sonic gauge measurement system, it can be stated that:

This measurement system will be connected with a shock absorber on the base of the subsea system.

A sonic receiver will be installed with this system which will procure data for the gauge and will be embedded within the system.

The gauge system will calculate the pressure of the bottom portion of the plug and will send it over the plug to the receiver which will conserve the information to onboard memory.

The specifications of this measurement system will be as follows:

Battery life	Up to 8 years
Material	Super duplex and Inconel
Diameter	33.4 mm (1.31 inch)
Length	1300 mm to 1800 mm (51.2 inches to 70.9 inches)
Maximum options of pressure rating	5000, 10000, 15000 psi
Maximum temperature rating	125°C (257°F) and 150°C (302°F)
Configuration of multi-sensor	Above and below the barrier
Downhole sensor	Piezo and Quartz
Transmission distance	Unlimited coverage with the stations of Sonicrepeater

Interaction type	Simplex and Duplex (SonicSync - two way)
The transmission speed of real-time data	Maximum 30 seconds
“**Surface Read Out (SRO)**" real-time	Yes

Table 2: Installation specifications of the measurement system

Task 4

Crucial Appraisal For The Management System

As it has been elaborated in the above portion, the measurement technology which is a sonic gauge can be presented as a reliable process of making an investigation with a large variety of activities. Moreover, to be utilized for error detection, this advancement will be also utilized for evaluating the thickness of the pimples of the subsea manufacturing system, boilers, vessels and storage tanks. Just like the error detection within the ultrasonic advancement, this measurement system will utilize the sound waves (which are ultrasonic) for procuring a read (which is acute) of the resting thickness of the wall or the aspects that are subject to either erosion or coercion. The thickness in this scenario can be evaluated by sending out the vibration and evaluating the time it will consume for the travelling sound to convey from the transducer via the longer side of the element, and return back to the transducer (TANG et al. 2019). In this case, the time of the signal travelling can be converted to the thickness of the wall (remaining) by the tool and presented in either metric or imperial units. However, to procure an acute reading of the pipe's thickness, boilers, and vessels the utilization of this measurement system will be significant and it will provide assurance on the basis of fitness as well as the safety of the service. In addition, this measurement system will be utilized for observing the thickness of any types of steel components utilized under this subsea system (Chang et al. 2019). Generally, it has been seen that these steel components are utilized to bring stability to pipelines. The more the thickness value comes the higher the reliability of the system will be. The main appraisal of the measurement system comes in this case as it will have the ability to observe the corrosion through the thickness of the wall and it will also make a test on the plastic pipes as well as ductile irons.

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