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DESIGN AND MODELLING OF BACK PRESSURE REGULATOR AND MEG FILTER FITTED TO SUBSEA SKID EQUIPMENT DEPLOYMENT

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Abstract: SSCD is offshore marine structure used for equipment deploying into deep sea. Retrieval of subsea equipment using conventional retrieval tools is difficult due to absence of lifting arrangements and the tools may damage. When Subsea equipment is damaged, it needs to be retrieved and taken to the offshore rig platform for maintenance. This process usually takes 72-96 hours. During the retrieval of Subsea equipment, the process is disrupted, to overcome these difficulties a special SSCD frame (Back pressure regulator and MEG Filter) is designed to avoid damaging of equipment, to reduce operational time. The main aim of this project is to design Back pressure regulator, MEG Filter and analysis of various conditions of SSCD, when the Back pressure regulator and MEG Filter components are to be fitted to SSCD frame. The frame deploys the components in subsea and thus, the frame is called as SSCD. (Subsea skid for component deployment). Back pressure regulator is a control valve which maintains a constant fluid output. MEG Filter is an injection valve acts as a hydrate inhibitor when extracting the gas from undersea.

Keywords: Subsea Component Deployment, MEG Filter, Back Pressure Regulator, Offshore, Onshore, Retrieval.

I. INTRODUCTION

Subsea equipment Deployment system deploys Subsea Equipment into Seabed where the process is going on. It can deploy large equipment into larger depths. The main objective of subsea equipment deployment systems is to safely deploy and position the subsea equipment considering the Human safety with low cost.

In general, any operation performed in fluidic environment which is out of reach for manual intervention, requires one or more tools installed there within that work in an automatic mode. A suitable example of such an environment is underwater environment, and more particularly, subsea environment. Subsea generally refers to equipment, technology and methods used for underwater operations such as scientific study of organisms in the sea or ocean, geological oceanography, offshore oil and gas production and underwater mining. Generally, retrieval tools are used for subsea intervention, wherein permanently installed subsea equipment is retrieved for repair or refurbishment using the retrieval tools. Generally, tool deployment system is used to deploy and handle the installed subsea equipment. Back pressure regulators (BPRs) intended for subsea deployment are in-line devices that regulate inlet pressure when it falls below a specified set point. Subsea BPRs are typically installed before production flow line injection points to prevent fluids from draining in a non-regulated condition when hydrostatic head exceeds injection point pressure.

A production system in subsea consists of a subsea tree, subsea completed well and wellhead systems, subsea tie-in to flow line system, jumpers, umbilical and riser system and subsea equipment to operate the well. A subsea tie-back is used to connect a newly operated production well to an existing subsea production system.

The subsea equipment is generally subjected to harsh environment in deep sea, because of high pressure and high temperature gradients. Therefore, in all offshore pipeline the transportation of fluids like oil, gas, water or their mixtures should be analysed to optimize performance and minimize the operational risks.

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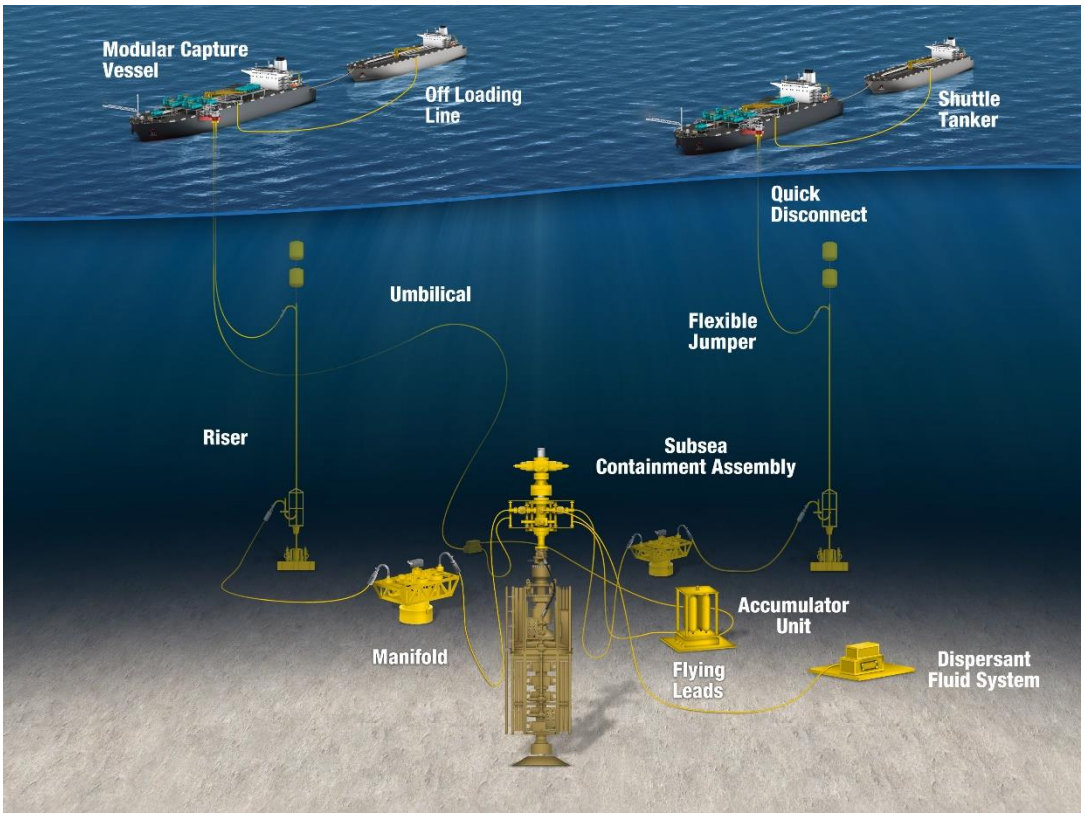

Fig1. Layout of the Subsea equipment under the sea

Back Pressure Regulator:

Back pressure regulator is a control valve which maintains a constant fluid output. When fluid pressure in the process at the inlet of the BPR exceeds the setpoint, the regulator opens to relieve the excess pressure.

MEG Filter:

MEG (Mono Ethylene Glycol) is used as hydrate inhibitor when extracting natural gas from a reservoir. Lean MEG (90% MEG by weight and 10% Water by weight) is injected at the wellheads, where it is mixed with formation water (saturated with formation salts) and later with condensed water through the gas pipeline. When arriving to the slug catchers the Rich MEG (40-60% MEG by weight, depending on the well and on its age, water to 100%) is taken out and regenerated back to Lean MEG in a regeneration system.

Beside water removal, the regeneration system is responsible for removal of salts, both high soluble (NaCl) and low soluble ones (e.g. CaCO3, Mg(OH)2, pipeline corrosion products like FeS). Accumulation of these salts, especially low soluble ones, may result in major issues in key equipment within the whole MEG loop, thus harming production stability.

II. METHODOLOGY

1. Modeling of Back pressure regulator and MEG filter (which are to be fitted on SSCD frame) are created using CATIA software according to the input drawings.
2. Optimal design by performing simulation of the 3D models in Ansys of following conditions on SSCD frame.

- 1 Back Pressure Regulator alone in place.
- 1 Back Pressure Regulator + 1 MEG Filter in place.
- 2 Back Pressure Regulator + 1 MEG Filter in place.
- 2 Back Pressure Regulator + 2 MEG Filter in place.
- 1 MEG Filter alone in place.

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III. MODELLING

Modelling of Back Pressure Regulator and MEG Filter is done on CATIA Software.

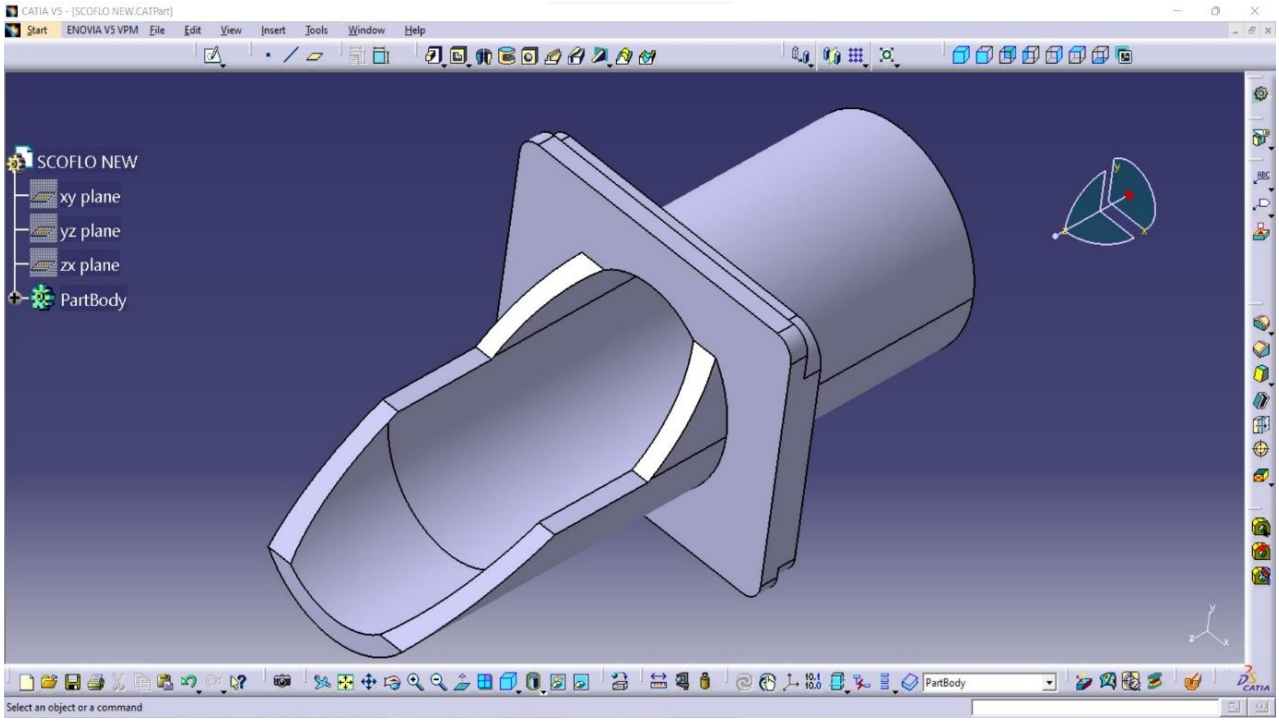

Fig 2. 3D Model of Back pressure regulator.

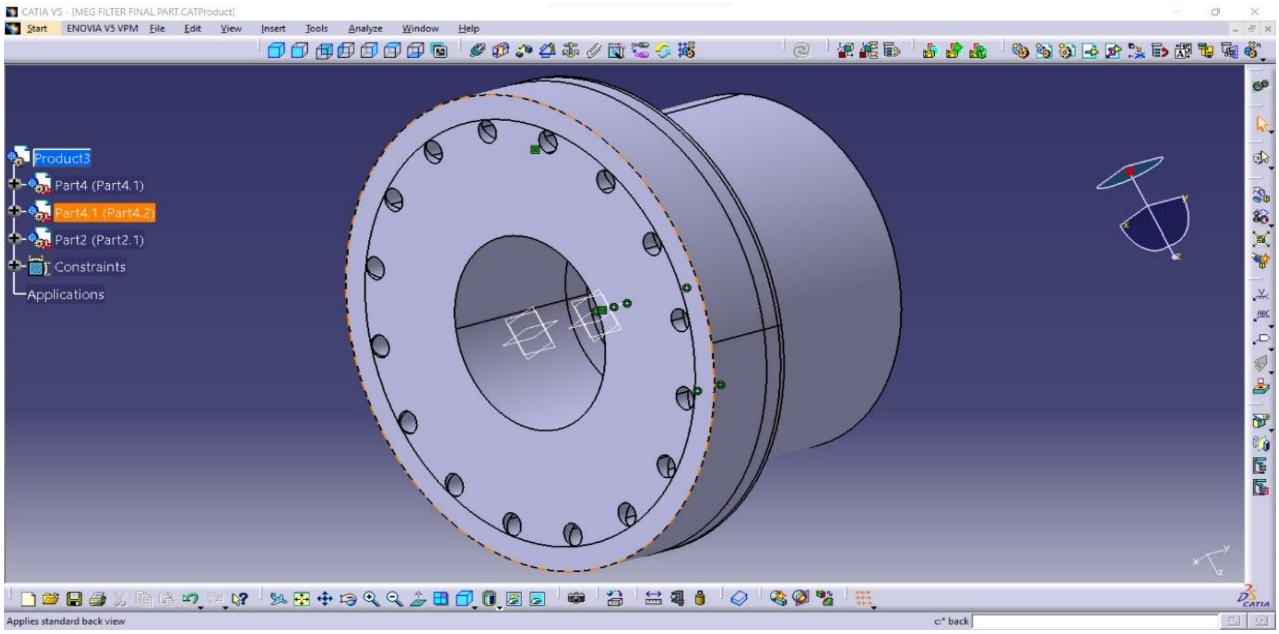

Fig 3. 3D Model of MEG Filter.

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IV. ANALYSIS AND RESULTS

Analysis is performed on the following load conditions

CASE- 1: 1 Back Pressure Regulator alone in place.

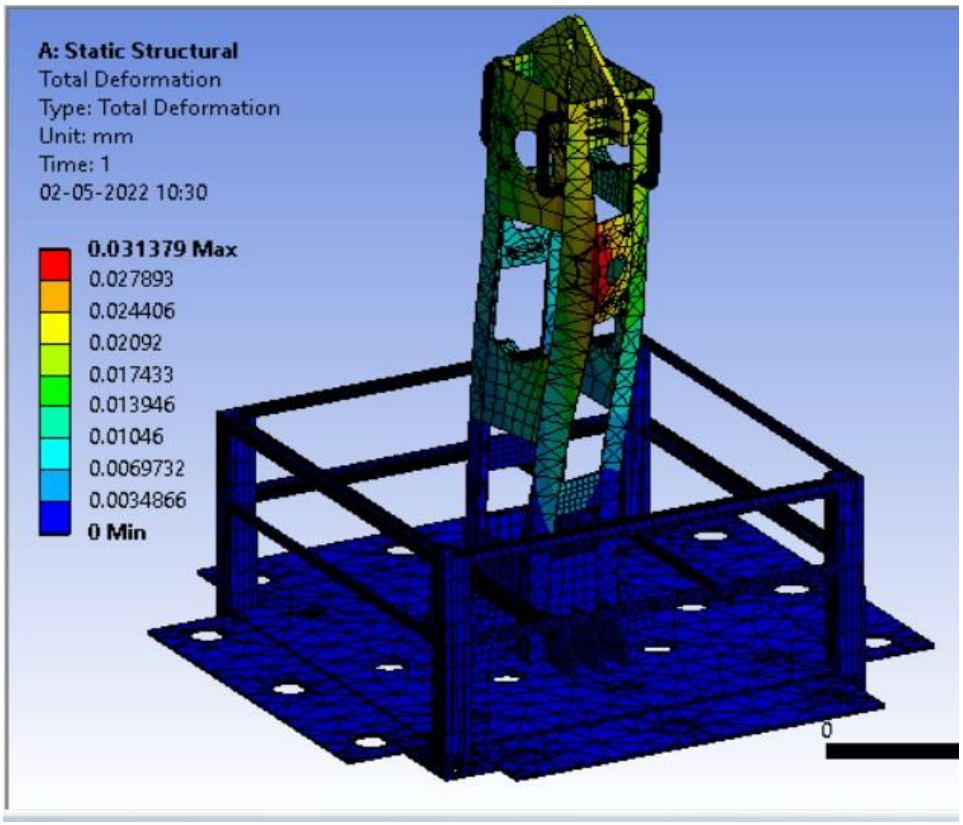

Fig 4. Analysis of 1 Back Pressure Regulator alone in place.

In this case weight of a Back pressure regulator, Receptacle and Stab Plate are to be considered. All these are bolted onto a plate having 4 holes, this is where the load will be acting. Along with this, the assembly is supported by a bracket welded on top of a plate and load will be acting on this bracket too. The result from the Static Analysis gives that the maximum stress is 1.412 Mpa at anchor and total deflection is 0.056249 mm >> 0.06 mm, which is very nominal.

CASE- 2: 1 Back Pressure Regulator + 1 MEG Filter in place.

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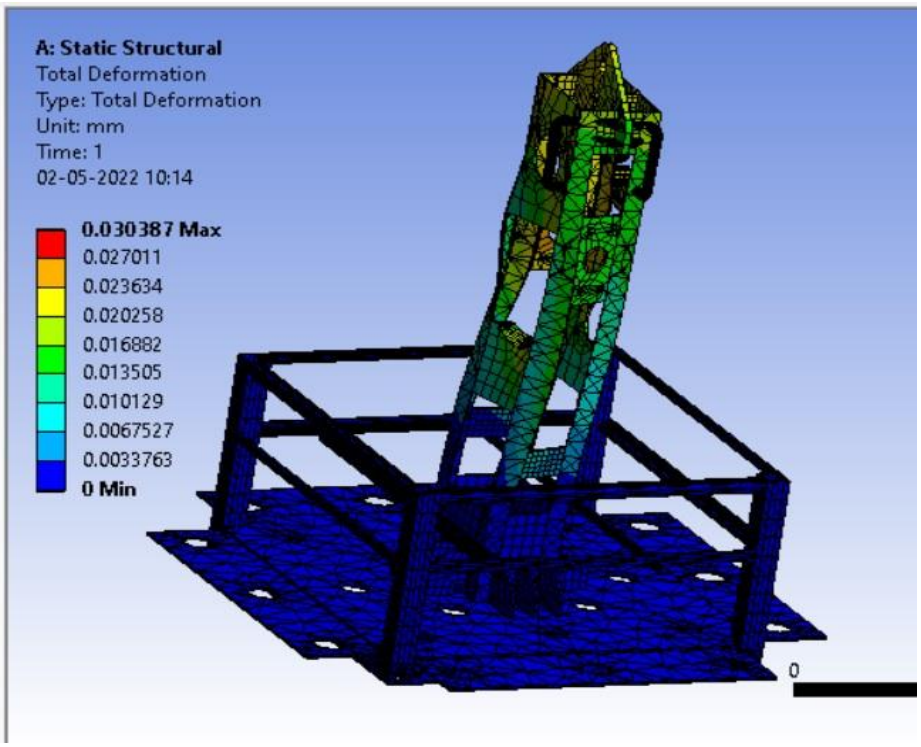

Fig 5. Analysis of 1 Back Pressure Regulator and 1 MEG Filter

CASE- 3: 2 Back Pressure Regulators + 1 MEG Filter in place.

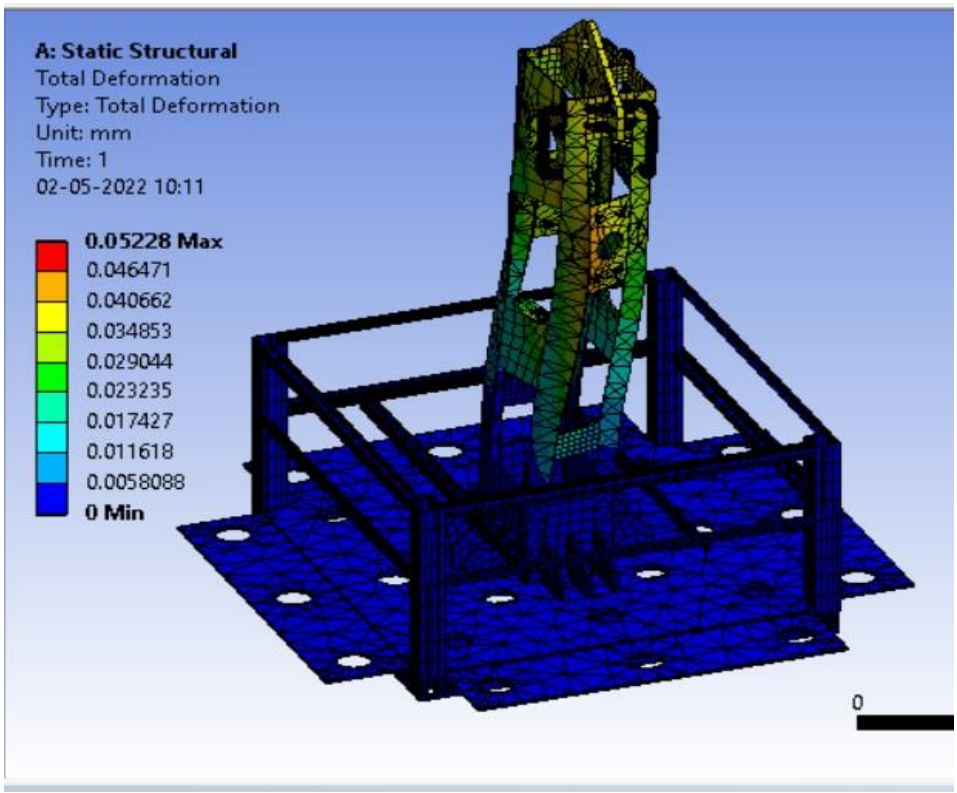

Fig 6. Analysis of 2 Back Pressure Regulators + 1 MEG Filter in place.

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CASE- 4: 2 Back Pressure Regulators and 2 MEG Filters in place.

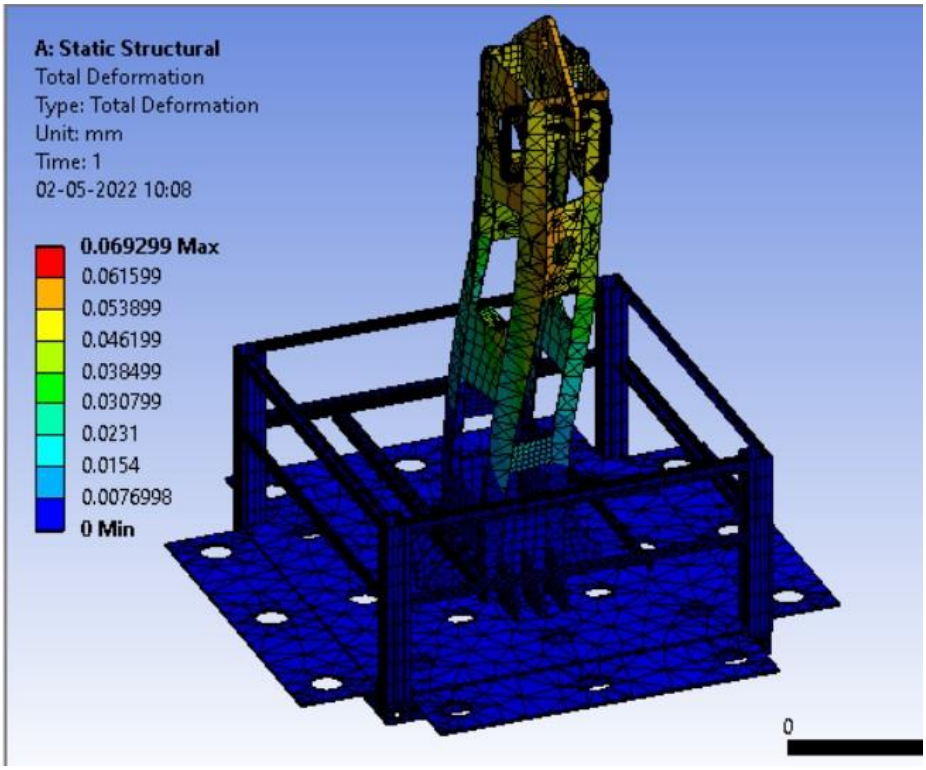

Fig 7. Analysis of 2 Back Pressure Regulators + 2 MEG Filters in place.

CASE- 5: 1 MEG Filter alone in place.

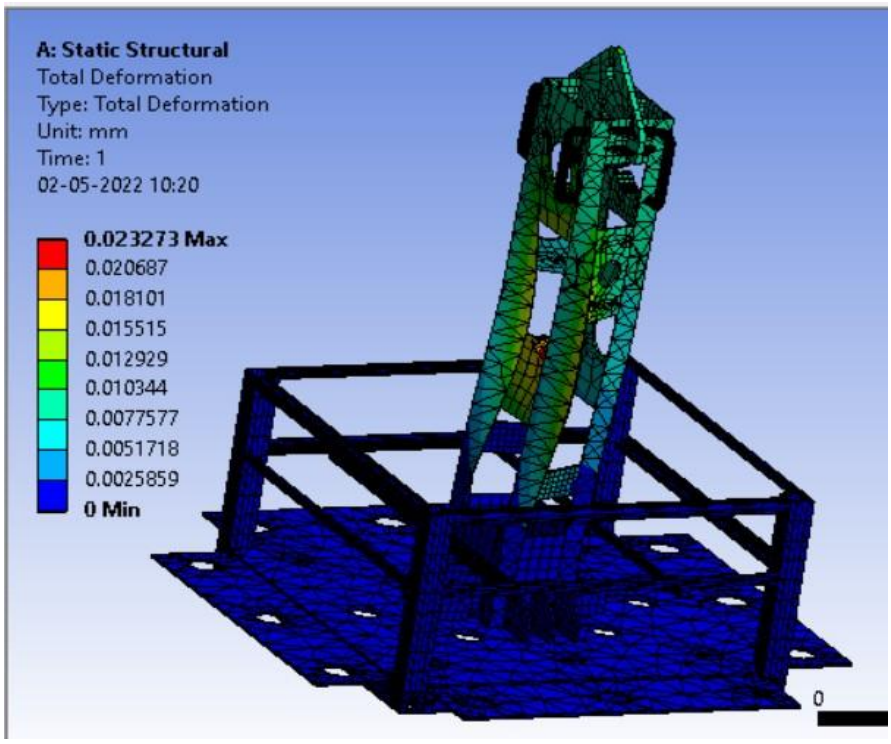

Fig 8. Analysis of 1 MEG Filter alone in place.

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In all the cases, the total deformation is very small and hence the frame is within safe limit.

ADVANTAGES

The breakdown time is reduced and the process will be continued with minimum interruptions. By using SSCD frame, damaging of tool or equipment during the retrieval can be prevented. It reduces the time for tracing tool deployed in the fluidic environment. It reduces operational time for retrieval. It is cost effective.

APPLICATIONS

The SSCD frame has special application in the Subsea equipment handling. It makes the retrieval process and repairing process easy. It finds major application in Subsea retrieval requirements for Equipment deployment and Tools.

V. CONCLUSION

When Subsea equipment is damaged, they need to retrieved and taken to the offshore rig platform for maintenance. This process usually takes 72-96 hours. During the retrieval of Subsea equipment, the process is disrupted, Retrieval of subsea equipment using conventional retrieval tools is difficult due to absence of lifting arrangements and the tools may damage. To overcome these difficulties and minimize the breakdown time of production. a special SSCD frame (Back pressure regulator and MEG Filter) is designed to avoid damaging of equipment, to reduce operational time. SSCD is offshore marine structure used for equipment deploying into deep sea.

FUTURE SCOPE

Further extension of this thesis can be used in designing the retrieval equipment like SSCD frame. It simplifies the design process and ensures less self-weight and further reducing the requirement of large lifting devices.

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