Offshore Oil Wells Integrity: STPA Analysis of the Subsea Christmas Tree

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Brazilian energy matrix (MME, 2020)
Pre Salt depths
CONTEXT

Subsea Christmas Tree Scheme (ALVES, 2021)
SYSTEM BOUNDARIES

Floating Production Unit

ROV
SYSTEM DETAILS

**LOSSES**
- Loss of Human life or Injured People
- Loss or damage of production equipment
- Loss of the well
- Loss of Production
- Loss of environmental integrity
- Indirect monetary Losses
- Loss of reputation

**HAZARDS**
- Oil well without control over liquid flows: L3-L4-L5-L6-L7
- Oil well without control over gas flows: L1-L2-L3-L4-L5-L7
- Oil well with production flow reduced or interrupted: L4
- Oil well operate outside of the required pressure envelope: L1-L2-L3-L4-L5-L6-L7
CONTROL STRUCTURE

PROCEDURES

OPERATOR

OPEN/CLOSE VALVES:
SCSSV, M1, W1, M2, W2, XO, PXO

SENSORS:
PRESSURE IN THE PRODUCTION CHAMBER
TEMPERATURE IN THE PRODUCTION CHAMBER
PRESSURE IN THE ANNULAR CHAMBER
PRESSURE NEXT TO THE PRODUCTION PACKER

VISUAL

OPEN/CLOSE VALVES:
SCSSV, M1, W1, M2, W2, XO, PXO

ROV

SUBSEA XMAS TREE
CONCLUSIONS

- UCAs → 40
- Loss Scenarios → 541 over which:

- Component failure: 38%
- Communication failure: 26%
- Process model/ Human failure: 36%
ONGOING WORK

STPA HANDBOOK

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This handbook is intended for those interested in using STPA on real systems. It is not meant to introduce the theoretical foundation, which is described elsewhere. Here our goal is to provide direction for those starting out with STPA on a real project or to supplement other materials in a class teaching STPA.

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