Seabed preparation on Edradour Glenlivet project 2014-2015 campaigns

Loic Delebecque, TOTAL E&P
EDRADOUR GLENLIVET PROJECT

- Edradour and Glenlivet are gas condensate fields located approximately 100km North West of the Shetland Isles, in water depths ranging from 300m to 430m.

- Subsea development, tied back to existing Laggan-Tormore system and installation of a Condensate Mercury Removal Unit at Shetland Gas Plant.

- Two 12” production flowlines of 17km and 35km, with design capacity up to 200MMscfd with associated condensate.

- Edradour and Glenlivet are planned to come on-stream in 2017 and 2018 respectively.
EDRADOUR GLENLIVET PROJECT OVERVIEW

~ 150 km of pipelines and umbilicals overall
SEABED CONDITIONS WEST OF SHETLANDS

• Seabed boulders (glacial dropstones) prevalent offshore West of Shetlands

Glacial dropstones, involving rocks falling out of icebergs, are one of the most common types of dropstone preserved in the geological record, particularly when deposited in low-energy deep sea or lake environments.

Dropstone - Wikipedia, the free encyclopedia

• Surface boulders are a constraint for pipeline and umbilical installation (risk of overstressing/damaging product)

• Sub-surface boulders are a constraint for trenching installed pipelines (risk of damaging plough/trenching equipment)
SEABEAD PREPARATION TIMELINE ON EDRADOUR GLENLIVET

May – June 2014
Geophysical and geotechnical early survey on Glenlivet
MBES, SSS, CPT, core samples
Kommandor Calum

July 2014
Geophysical and geotechnical pre-engineering survey
MBES, SSS, CPT, core samples
Siem Daya 2

July 2015
Boulder removal
Viking Neptun

September 2015
Pre-ley rock carpet installation
Stornes

August – October 2016
Post lay rock installation (pipelines, umbilicals)
Stornes and/or Nordnes

July 2017
Post lay rock installation (GRP covers, spools, well jumpers)
Stornes and/or Nordnes

MBES – Multi Beam Echo Sounder
SSS – Side Scan Sonar
CPT – Cone Penetration Test
Laser sizing of boulders (green lines set to 0.5m separation)

**BOULDER REMOVAL – INITIAL ROUTE SURVEYS**

**20 May – 26 June 2014**
Kommandor Calum surveys, Glenlivet

**2 – 21 July 2014**
Siem Daya 2 surveys, Edradour – ILT3 – Laggan

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BOULDER REMOVAL – TARGET ASSESSMENT

Initial assessment (20m corridor)  1692 targets
(Multi Beam Echo Sounder + Side Scan Sonar + laser sizing)

Corridor refinement  1414 targets

Boulder size criteria (prop height) > 0.5m
Reduction of installation tolerances (corridor width)  204 targets
OFFSHORE OPERATIONS

28 June – 4 July 2015

Viking Neptun – confirmation survey & boulder removal

ROV ruler used to measure boulder height (0.5m critical height)
OFFSHORE OPERATIONS – SUMMARY

Total of **199 boulders** moved to disposal corridor in just over **4 days (4.2 days)** offshore on location → **~2 boulders / hour**
PRE-LAY ROCK DUMPING

• Specific foundation (rock carpet and large mudmats) required on 6 off FLETs and 1 off ILT due to soft seabed conditions (soft clay overlaid by veneer of silty sand)

• Rock carpet required below Edradour production pipeline cooling section (~1.5km long) to limit embedment of pipeline and ensure required gas cooling
ROCK CARPETS DESIGN

- Geotechnical calculations performed to design required design of rock carpet
  - Subsea structures weight
  - Pipeline/spool loads
  - Fishing design loads (overtrawlability)
ROCK DUMPING OFFSHORE OPERATIONS
Accurate placement of rock on seabed using fall pipe diverters and live multi beam echo sounder survey
Height tolerance: [0; +0.1m]
**ROCK CARPET INSTALLATION**

- Orange lines $\rightarrow$ FPROV track whilst filling boxes to target height
- Yellow $\rightarrow$ target height
- Blue $\rightarrow$ low spots needing filling

- Typical outcome from rock dumping campaign $\rightarrow$ DTM (Digital Terrain Model) survey charts
SUMMARY AND CONCLUSIONS

• Importance of high quality initial geophysical surveys

• Boulder relocation campaign successfully completed by Viking Neptun in just over 4 days in July 2015
  • Boulder grab method proved adequate for the scope
  • Initial project assessment/alternative using seabed scar plough was forecasted to last ~30 days with no guarantee on effectiveness

• Pre-lay rock dumping campaign successfully completed by Van Oord Stormes in September 2015
  • Very accurate rock placement (actual seabed height accuracy down to 0.05m) with the state-of-the-art MBES data processing capability

• Special thanks to Technip Norway for the performance of this successful offshore works and thanks to our partners DONG Energy and SSE for all their contribution