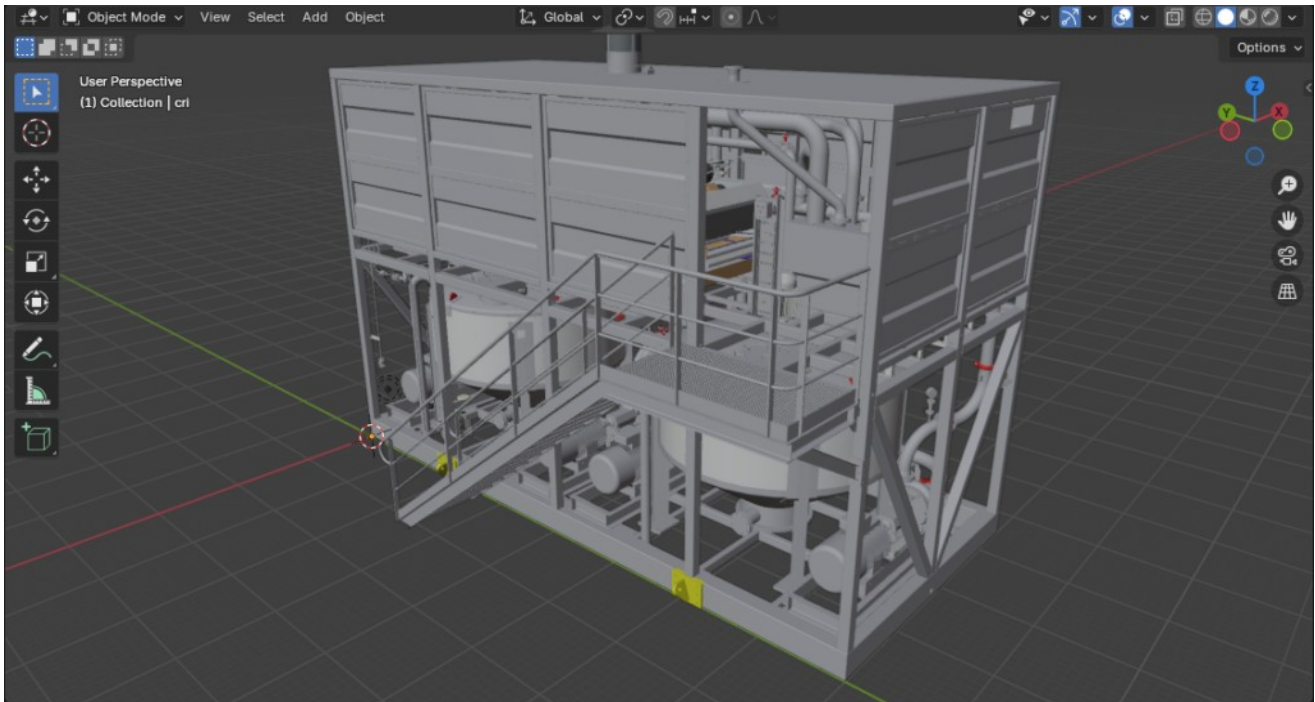


CASE STUDY

Drill Cuttings Reinjection Unit

West Elara Jack-Up Drilling Rig

Design · Engineering · Procurement · Classification · Pre-Commissioning



RIG	RIG CLASS	LOCATION	CLASSIFICATION
West Elara Jack-Up	Drill (N) Class	North Sea / Norway	DNV + NORSOK

OVERVIEW

Engineering a Zero-Discharge Solution for North Sea Jack-Up Operations

Offshore drilling operations in Norwegian and North Sea waters are subject to some of the strictest environmental discharge regulations in the world. Under OSPAR Convention obligations and Norwegian Environment Agency requirements, the discharge of oil-contaminated drill cuttings and drilling fluids to the seabed is prohibited. For operators working with oil-based mud (OBM) or synthetic-based mud (SBM) systems, cuttings reinjection (CRI) has emerged as both the technically preferred and cost-effective compliance solution.

Ingeniat was engaged to design, engineer, and support the procurement and commissioning of a complete Cuttings Reinjection Unit for installation onboard the West Elara, a Drill (N) Class jack-up drilling rig. The unit operates continuously in a Zone 1 hazardous area, receiving cuttings from the solids control system and injecting slurry into a designated subsurface disposal formation at high pressure.

The project was executed under NORSOK D-001 Drilling Facilities and DNV OSS-101 Rules for Classification of Offshore Drilling and Support Units. All lifting operations were engineered to comply with DNV's Rules for Planning and Execution of Marine Operations.

PROJECT FACTS

Key Parameters

Zone 1 Hazardous area classification	50–200 bbl/min Typical injection rate range
10,000 psi Max injection pressure	20–30% Solids by volume in slurry
250–300 µm Target particle size post-grind	DNV + NORSOK Governing standards

THE CHALLENGE

Environmental Compliance Under Operational Constraints

The West Elara operating environment presented a compound set of engineering constraints. The rig's deck space is inherently limited on a jack-up platform, requiring the CRI unit to be configured as a compact, self-contained module without compromising access for maintenance or safe operation by rig personnel. The unit needed to be installed in a pre-existing deck area, imposing structural load constraints on the foundation design and requiring detailed interface engineering with the rig's existing piping, power, and control systems.

The Zone 1 area classification created stringent requirements for all electrical equipment, instrumentation, and control systems. All components required ATEX or IECEx certification to the appropriate equipment category. Sour service (H₂S) potential in the disposal formation required all wetted components and piping to be specified and tested to ISO 15156 / NACE MR0175 requirements.

The environmental and cost case for the project was direct: traditional cuttings handling via skip-and-ship or thermal treatment involves continuous logistical expense — helicopter and vessel transport, onshore thermal desorption or landfill disposal, and associated HSE exposure. The CRI solution eliminates this cost stream entirely for the duration of operations while meeting zero-discharge requirements.

“Locations with strict environmental regulations require integrated waste management solutions. Traditional approaches result in significant expenses in transportation and final treatment of cuttings. Cuttings reinjection allows for significant savings while ensuring compliance with zero-discharge requirements.”

Ingeniat Project Documentation

Full-Lifecycle Engineering Delivery

Ingeniat's scope covered the complete engineering lifecycle of the CRI unit, from initial concept and detailed design through to procurement support, installation oversight, mechanical completion, and commissioning.

SCOPE AREA	DELIVERABLES & ACTIVITIES
Feasibility & Concept Design	Operating envelope definition, injection well compatibility assessment, unit configuration and layout concept, interface identification with rig systems, hazardous area extent drawing.
Detailed Engineering Design	Full 3D model with all disciplines integrated: structural steelwork, process piping, P&IDs, instrumentation, electrical, ATEX classification. All interferences resolved before production drawing issue.
Structural Analysis (FEA)	Finite element analysis of primary structural components including baseframe and foundation pad connections. Onshore lifting analysis to DNV Marine Operations rules — all lift points, rigging, and sling arrangements assessed and certified.
Equipment Specification & Procurement	Datasheets and specs for major equipment including high-pressure injection pumps, cuttings grinder, slurry mixing and storage tanks, piping, valves, and instrumentation. Full supply chain management including vendor evaluation, VDR, expediting, freight, customs clearance, and delivery.
Hazardous Area & Safety Engineering	HAZOP study, FMEA for critical equipment, SIL assessment for safety instrumented functions, explosion risk assessment and zoning drawings, ESD logic development and integration specification.
Installation Engineering	Detailed installation procedures and work packages. Lift plan for deck placement. Installation sequence optimisation. Structural modification design for foundation integration. Interface design with rig piping and control systems.
Mechanical Completion & Testing	Mechanical completion checklists. Statutory pressure testing. Sounding tables for storage tank calibration and level transmitter verification. Calibrated test equipment coordination.
Precommissioning & Commissioning Support	Functional testing procedure development. Resource coordination for tank fill and power supply. Support to on-site commissioning team, system optimisation, and performance verification.
Documentation & Training	Complete as-built documentation: operating manuals, maintenance procedures, inspection schedules, and crew familiarisation materials.

Governing Standards and Classification

The CRI unit was designed and engineered to comply with the following primary standards and regulatory requirements. Design review submission, technical query resolution, and the preparation of all documentation required for formal class approval, was handed by the team.

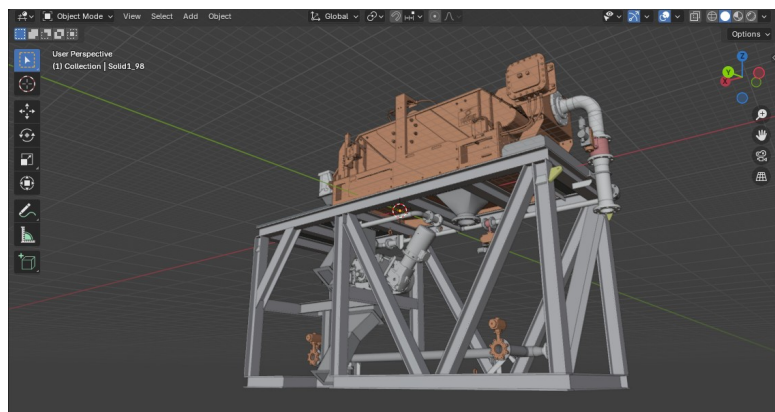
STANDARD / REQUIREMENT	APPLICATION
NORSOK D-001	Drilling Facilities — overall design and operational philosophy for the drilling system and associated equipment
DNV OSS-101	Rules for Classification of Offshore Drilling and Support Units — primary classification standard governing the CRI package design
DNV Marine Operations	Rules for Planning and Execution of Marine Operations — applied to all onshore and offshore lifting operations associated with the unit
ATEX / IECEx (Zone 1)	All electrical equipment, instrumentation, and junction boxes specified and certified for Zone 1 hazardous area service
ISO 15156 / NACE MR0175	Materials selection for sour service (H ₂ S exposure potential in disposal formation) — all wetted components compliant
NORSOK Z-015	Temporary equipment requirements applied to ancillary modules as applicable
API 6A / API 16C	High-pressure wellhead equipment and choke/kill manifold components where applicable
IEC 61511 (SIL)	Safety instrumented system design and SIL verification for shutdown functions

TECHNICAL DETAIL

Process Description — CRI System Operation

Drill cuttings are transferred from the solids control system (shale shakers and centrifuges) to the CRI unit via a cuttings handling system. On arrival, cuttings are screened to remove oversize material before entering the grinding circuit. The grinder reduces particle size to a target distribution of 250–300 microns — a critical parameter, as oversized particles cause pump wear, plugging of injection lines, and loss of injectability in the subsurface formation.

Ground cuttings are mixed with seawater in the slurry preparation tank to produce a homogeneous slurry at 20–30% solids by volume. Chemical additives — including viscosity modifiers and settling inhibitors — are dosed as required by formation conditions. The slurry is transferred to a storage/buffer tank before high-pressure triplex or plunger pumps force it down the injection annulus at pressures up to 10,000 psi.



3D Design Methodology

Every discipline was modelled within a single integrated 3D environment — structural steelwork, process piping, instrument tubing, electrical cable trays, and HVAC were built concurrently. Potential interferences were identified and resolved before any production drawing was issued for formal approval, eliminating costly rework during fabrication.

All project participants worked from the same reference model. Controlled revision management ensured that design changes were propagated to all recipients simultaneously. The 3D model was also used for client design reviews, allowing the operator to confirm spatial fit, access for maintenance, and operational ergonomics before any steel was cut.

PROCUREMENT & SUPPLY CHAIN

Equipment Procurement and Logistics Management

Ingeniat provided assistance during procurement of long-lead equipment and critical materials, thorough the complete supply chain from technical specification through to rig-side delivery. This included vendor prequalification, purchase order management, vendor data review (VDR), inspection at manufacturer premises, expediting, freight forwarding, customs clearance, and final delivery logistics.

- ✓ **Cuttings grinder:** Wet grinding unit; target particle size distribution; wear-resistant materials throughout
- ✓ **Slurry mixing and storage tanks:** Atmospheric-rated vessels with agitators; level measurement by calibrated transmitters
- ✓ **Process piping and valves:** Pressure piping to ASME B31.3; flanged connections throughout; sour service material grades
- ✓ **Instrumentation package:** Pressure, flow, level, and temperature transmitters; ATEX Zone 1 rated; integration with rig DCS
- ✓ **Control panel:** Zone 1 local control panel; ESD integration with rig safety system; remote HMI provision
- ✓ **Structural steelwork:** Primary frame to NORSOK M-101 specification; coated to NORSOK M-501 offshore specification

INSTALLATION & COMMISSIONING

Onsite Engineering and System Verification

Ingeniat provided assistance to the customer's service team during the installation and commissioning phases. All equipment received at site was reviewed against manufacturer documentation to identify any pre-installation requirements before the unit was energised.

A mechanical completion programme was developed and executed against a structured checklist. Pressure testing of all piping systems was carried out to ASME B31.3 requirements. Slurry storage tanks were filled to capacity to generate sounding tables for level transmitter calibration, verifying that the instrumentation accurately reflected actual tank inventory across the full operating range.

Functional testing and precommissioning was conducted with the injection pumps offline, verifying control logic, instrument signal integrity, ESD trip function, and interlock performance before any high-pressure operations commenced.

OUTCOME

Delivered Capability and Environmental Value

The completed CRI unit provides the West Elara with a fully certified, continuously operable zero-discharge cuttings disposal capability that removes the logistical and cost burden of skip-and-ship operations for the duration of the drilling campaign. The unit operates in continuous injection mode, processing cuttings from the solids control system in real time without interruption to drilling operations.

The unit was commissioned on schedule within the planned production window.

DNV + NORSE

Compliance

Zone 1

Full ATEX compliance throughout

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Cuttings discharged to sea

100%

Scope delivered to specification

RELATED CAPABILITIES

Drilling Solutions — Broader Scope of Supply

The West Elara CRI project is representative of Ingeniat's broader capability in offshore drilling systems engineering. The same design methodology, classification approach, and project management framework is applied across our full range of drilling-related services.

Drill Cuttings Handling Systems

Collection conveyors, transfer systems, skip loading

Drilling Mud Treatment Systems

Degassers, centrifuges, mud mixing and weighting

Drilling Mud Cooling Systems

Mud cooler skid design for high-temperature formations

Drilling Mud Mixing Systems

Liquid mud plant, barite/bentonite weighting systems

Chemical Storage Skids

ATEX-rated chemical injection and storage packages

Driller Cabins

Zone 1 pressurised; structural, HVAC, fire & gas, ergonomics

Local Equipment Rooms (LERs)

A60 fire-rated; Zone 1/2; permanent or temporary (NORSOK Z-015)

Offshore Containers

DNV 2.7-1 / 2.7-3 certified; custom configuration

Filtration & Separation Systems

Sand handling, produced water, bulk loading filter packages

Bespoke Offshore Modules

Chemical injection, methanol injection, gas scrubbing, riser gas handling

COMPLEMENTARY SERVICES

Beyond drilling systems, Ingeniat provides services directly relevant to offshore drilling operators and rig owners across green ship solutions (BWMS engineering, EGCS retrofits, waste treatment), structural FEA and analysis (class-accepted FEA for pressure vessels, lifting analysis, fatigue assessments), and compliance advisory (CII, EU ETS, and MARPOL compliance for OSVs and support fleet operators).

Discuss Your Project

For technical enquiries regarding cuttings reinjection engineering, offshore module design, or classification support, contact us directly.

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