

Lessons Learned — NOA/Valhall Fenris Prover Projects

For Application to Snorre A SVP085 Project (GM-8501-1447)

Source Projects:

- SP-00525 — Hugin A (NOA), SVP050, Crude Oil Export Metering
- SP-00577 — Valhall Fenris (PWP), SVP015, Condensate Fiscal Metering
- SP-01415 — Snorre A SVP (current bid, SVP085)

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1. Reference Project Comparison

Parameter	Hugin A (SVP050)	Valhall (SVP015)	Snorre A (SVP085)
Client	Aker BP via TechnipFMC	Aker BP via TechnipFMC	Equinor via Guidant
Fluid	Crude oil	Condensate	Crude oil
Flow range	71.4–1,034.5 m³/h	9.1–211.6 m³/h	67–750 m³/h
Design pressure	27 barg	17.7 barg	49 barg
Pipe class	BD20 (CL 300, Duplex SS)	AD20 (CL 150, Duplex SS)	BD20X (CL 600, per TR2000)
Connections	14" CL 300 RF WN	8" CL 150 WN	12" CL 600 RTJ
Barrel material	316SS standard	316SS standard	Duplex SS requested
Seal material	Carbon Fiber PTFE (crude)	Ekonol PTFE (condensate)	Carbon Fiber PTFE (crude)
Controller	Removed (special ATEX)	Removed (special ATEX)	Included (standard Honeywell)
Motor	690V 50Hz ATB (non-standard)	690V 60Hz ATB (non-standard)	230V 3ph 60Hz (confirm 50Hz)
Coating	M-501 2A (TSA)	M-501 2A (TSA)	M-501 6C (recommended)
Modular split	Not required	Not required	Required (max 1.4×2.56×2.2m)
Re-assembly	N/A	N/A	Offshore on Snorre A
Honeywell PO no.	O-579505	O-636399	O-1010834

2. Pricing Benchmarks

2.1 NOA / Hugin A (SVP050) — Total USD 928,915

Pos	Item	USD
1	Honeywell Enraf SVP O050, 8" connections	718,333
2	Spare parts (2-year kit)	13,691
3	151.40 Liter Seraphin Can	34,303
4	Water draw kit fabrication	18,054
5	Project management + documentation	28,034
6	Shipment Arizona → Norway (air)	40,000
7	Painting NORSOK M-501 2A (TSA)	10,500
8	Extended warranty (additional 4.5 years)	66,000

2.2 Valhall / Fenris (SVP015) — Total USD 608,175

Pos	Item	USD
1	Honeywell Enraf SVP O015	436,521
2	Spare parts (2-year kit)	13,039
3	75.7 Liter Seraphin Can	30,023
4	Water draw kit fabrication	17,308
5	Project management + documentation	28,034
6	Shipment Arizona → Norway (air)	30,000
7	Painting NORSOK M-501 2A (TSA)	9,250
8	Extended warranty (additional 4.5 years)	44,000

2.3 Variation Orders — Total USD 31,438 per unit

VOR	Description	USD/unit
VOR 001	Seraphin Can verification at FAT	4,970
VOR 003	Design changes (water draw kit, brackets, motors, DBB valves, travel)	20,438
VOR 004	Post-FAT changes (solenoid valve, thermowell, 6Mo plugs, expediting)	6,030

2.4 Snorre A Pricing Considerations

- **SVP085 base price** will be significantly higher than SVP050 (USD 718k) due to larger displacement, higher pressure class (CL 600 vs CL 300), and Duplex SS barrel
- **Modular split engineering** is a new cost item not present in reference projects — expect substantial engineering add-on
- **Offshore re-assembly** costs (HE certified engineer + Intertek partnership suggested) — new scope

- **System 6C coating** is the recommended approach after NOA/Valhall TSA lessons
- **US tariffs** flagged as potential cost risk — verify current import duties
- **Budget VOR contingency:** ≥ USD 30,000 based on historical pattern

2.5 Payment Milestones (Reference)

- 40% at clarified PO
- 50% at accepted FAT
- 10% at final documentation

2.6 Delivery Time (Reference)

- 49 weeks from clarified PO to delivery
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3. Critical Technical Lessons

3.1 Coating — Use System 6C, NOT TSA (System 2A/2C)

Background: NOA/Valhall provers were specified with NORSO M-501 system 2A (TSA — Thermal Spray Aluminum). During execution, Honeywell advised strongly against TSA due to:

- High spray temperatures cause **deformation to the flow tube**
- TSA process affects the **hard chrome internal surface**
- Flow tube dimensional integrity is critical for prover calibration accuracy

Decision for Snorre A: Use **system 6C** per NORSO M-501 for process-wetted surfaces. This is aligned with TR0042 requirements and is the proven approach. Desert Coating in Arizona is qualified for NORSO M-501.

3.2 Seal Degradation During Storage

Issue: If a prover sits unused for 4+ years, the piston resting on seals causes "flat spots" leading to calibration failure.

Action for Snorre A: If there is a gap between FAT and commissioning, plan for **seal replacement** before putting into service. Include seal replacement kit in spare parts scope. Consider periodic exercising of the piston if storage exceeds 2 years.

3.3 Flow Tube Shipped Without End Flanges

Key insight from SP-01415 bid notes: For the modular split, the flow tube can be **shipped without end flanges** to fit within the 2.5m maximum module length. This is part of the modular split concept.

3.4 Prover Barrel Material

Reference: Both NOA and Valhall used standard 316SS barrels. For Snorre A, **Duplex SS** is requested due to higher design pressure (49 barg) and BD20X material specification. Fabrication is done in India with hard chrome finishing in the USA.

3.5 Motor and Electrical Configuration

Parameter	NOA/Valhall	Snorre A
Motor voltage	690V (non-standard)	230V 3ph
Motor frequency	50Hz (NOA) / 60Hz (Valhall)	60Hz (TQ-001: confirm)

Motor source	ATB via Lanne Elektriske (frame agreement)	Honeywell standard
Controller	Removed (special ATEX approach)	Included (standard Honeywell SVP controller)
ATEX	Individual component ATEX certs	Standard Honeywell Ex D

Lessons:

- NOA/Valhall required custom motors via frame agreement, causing delays and VORs
 - Snorre A uses standard Honeywell controller and motor — simpler ATEX certification
 - **Verify 60Hz frequency requirement** (TQ-001) — Norway standard is 50Hz
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4. Punch List Patterns — Recurring Issues

Both provers (SVP050 and SVP015) had nearly identical punch lists with 23–25 items. These represent systematic gaps at the Honeywell/TruStop factory:

4.1 Cable Routing (Items 1, 2, 3, 6, 8)

- Cables NOT routed through cable trays — most common issue
- Cable trays too small for number of cables
- Bonding cables not properly sleeved (Yellow/Green)
- **Fix:** Specify cable tray sizing with margin. Provide routing diagrams to factory before fabrication.

4.2 Tagging and Marking (Items 7, 9, 10, 14, 15, 17, 19)

- Tag marking missing on JBs, cables, switches, name plates
- This was a SIFAB/Factory shared responsibility — items appeared on every punch list
- **Fix:** Issue tag marking schedule with material/label procurement before factory work starts.

4.3 Material Substitution (Items 3, 5, 11, 13)

- Cable ties in SS 304 instead of SS 316
- Honeywell BOM specified only "SS" without grade
- Hexagon bolts inside cable trays instead of round-head bolts
- "Volvo list" (edge protection strips) not in SS 316
- **Fix:** Every BOM line item must specify SS 316 explicitly. Provide visual examples of edge protection requirements.

4.4 SIFAB-Scope Items (Items 11, 12, 13, 16, 18, 19, 21)

- 6Mo Parker plugs for vent valves
 - Jumper wiring in JBs per termination diagrams
 - Plug and chain for test thermowell
 - **Fix:** Pre-manufacture all SIFAB-scope items and ship as a kit to factory.
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5. Quality Concerns at Factory — 14 Issues Documented

5.1 Electrical Workmanship (10 of 14 issues)

Issue	Root Cause	Frequency

Cable braid armour destroyed during routing	Factory never did this before	First-time issue
Wire insulation damage pushing through glands	Insufficient care	Repeat risk
Optical switch cable damage from bolts in tray	Cable trays too small + sharp bolts	Design + workmanship
Cable lugs over-crimped	Wrong tool/operator error	Operator training
Wrong ferrule sizes (red 1.5mm ² on 0.75mm ² wire)	Unclear specification	BOM/specification gap
Wiring polarity reversed in transmitters	Human error	Operator training
Cables switched in JB terminals	Human error	Check procedure needed
Cable tray strips in SS 304 vs SS 316	BOM said "SS" only	Specification gap
Braid armour not grounded in transmitters	Unclear instruction	Wiring diagram gap
No ferrules on temperature sensor cables	Human error	Operator training

5.2 Mechanical Issues (4 of 14)

Issue	Root Cause
Hexagon bolts inside cable tray	Not specified to use round heads
Cable support distance too long (>10D)	Design limitation, approved
Cables resting on sharp edges	Not enough edge protection
"Volvo list" material (SS 304 vs 316)	Factory didn't understand the term

5.3 Key Takeaway for Snorre A

The Honeywell/TruStop factory is not familiar with NORSOK offshore electrical installation standards. Every specification must be explicit, with visual examples and step-by-step instructions. Do not assume factory knowledge of:

- Cable braid armour handling
- SS 316 vs SS 304 material grades
- Edge protection ("volvo list") requirements
- Scandinavian electrical terminology

Recommended approach for Snorre A:

1. Issue a "Factory Instruction Package" before fabrication with photos/diagrams for all non-standard items
2. Require factory sign-off checklists per cable
3. Send SIFAB engineer to factory for electrical installation review at 50% completion (before FAT)
4. Pre-manufacture all SIFAB-scope electrical items (JBs, cable glands, ferrules, tags) as a complete kit

6. Variation Order Root Causes and Prevention

6.1 VOR Summary by Root Cause

Root Cause	VOR Items	Total Cost/Unit
Design specification changes	Water draw kit (1/2" → 1"), solenoid valve, thermowell	~USD 14,000
Supplier/frame agreement changes	Motors (Siemens → Lanne), DBB valves (Emerson → MRC Global)	~USD 2,400
Insulation/mounting requirements	Temperature transmitter brackets	~USD 3,300
Client-requested additions at FAT	Seraphin can check, 6Mo plugs, expediting	~USD 11,500
Travel/coordination	Extra trip to Arizona	~USD 1,500

6.2 Prevention Measures for Snorre A

1. **Lock down water draw kit design early** — the 1/2" to 1" change was the single largest VOR item. Specify sizes in quote request.
2. **Confirm motor supplier and approvals** before PO — avoid frame agreement complications
3. **Include Seraphin can FAT verification** in base scope — this was VOR 001 on both projects
4. **Freeze design before FAT** — VOR 004 items were all post-FAT changes
5. **Include all 6Mo material requirements** in initial specification — the hex plug upgrade was a preventable VOR
6. **Build delivery schedule buffer** — expediting cost USD 4,500 per unit

7. Documentation Deliverables — Honeywell Standard Package

Based on the delivered documentation structure for SVP050 and SVP015:

Package	Contents
1. Drawings & Documents	GA drawing, service clearance, frame mounting, base structure, name plate, paint procedure/cert
2. SVP Test Procedures & Certificate	Gravimetric calibration, FAT certificates, instrument calibration certs, CMC traceability
3. Flow Tube - Welding	Certification package index, vendor checklists, casting MTRs, weld documentation for all components
4. Major Wetted Parts and Components	Material certificates for all wetted parts per EN 10204 3.1
5. SVP System Certifications	ATEX certs, PED, design code compliance, conformity declarations
6. SVP Controller and Transmitter	Controller documentation, transmitter specs and calibration

7. Motor Documents	Motor specifications, ATEX certification, test reports
8. Project-Specific Equipment	Configuration sheets, customer-specific items, special materials
9. SVP Operation & Service Manual	Full IOM manual for operation and maintenance

8. Shipping and Logistics

8.1 Reference Dimensions and Weights

Prover	Crate Size	Weight
SVP050 (Hugin A)	5.0m × 1.5m × 1.5m	~4,000 kg
SVP015 (Valhall)	4.3m × 1.3m × 1.3m	~2,500 kg
SVP085 (Snorre A)	TBD — larger than SVP050	TBD

8.2 Shipping Notes

- **Air freight** USD 30,000–40,000 per unit (Arizona → Norway)
- **Sea freight** significantly cheaper, 6–8 weeks transit
- Consolidating multiple units saves cost
- **Honeywell/TruStop address:** Kent Carpenter, 1725 W. 10th Pl., Tempe, AZ 85281 (Attn: Jonathan Koller)

8.3 Snorre A Modular Split Shipping Considerations

- SVP085 will be larger than SVP050 — must fit within 1.4×2.56×2.2m per module
- Flow tube shipped **without end flanges** to fit max 2.5m
- Skid frame split into sections — each must have lifting points per Norsok R-002
- Need lifting and handling description for each module
- **Weight of heaviest module** must be documented for platform crane capacity

9. Key Contacts and Roles (Reference)

9.1 NOA/Valhall Project Team

Role	Person	Organization
General Manager	Tom Sverre Falch	Sifab AS
Sales Manager	Sondre Falch	Sifab AS
Project Manager / Engineer	Oliver Vetland	Sifab AS
Prover Specialist	Sam (Samir) Sakota	Honeywell
Factory (TruStop)	Jon Koller, John Tyree, Dustin Rankin	Honeywell/TruStop
Sales / Commercial	Marcel Jurriens, Jean Chfar	Honeywell
Engineering	Sanjay Krishnan	Honeywell

9.2 Snorre A Team (Current)

Role	Person	Organization
Sales Manager	Sondre Falch	Sifab AS
Technical / PM	Tom Sverre Falch	Sifab AS
Honeywell Lead	Sidney Swart	Honeywell
Prover Specialist	Samir Sakota	Honeywell
Commercial	Mark Price, Eric van der Made	Honeywell
Client Tender Engineer	Torleif Espeland	Guidant

10. Action Items for Snorre A Based on Lessons Learned

#	Action	Responsible	Priority
1	Include Seraphin can FAT verification in base scope (not as VOR)	Sifab (quote)	HIGH
2	Specify water draw kit tubing size (1/2" or 1") in initial quote	Sifab (engineering)	HIGH
3	Prepare Factory Instruction Package with NORSOK electrical standards, photos, and visual examples	Sifab (Oliver)	HIGH
4	Confirm motor frequency (50Hz vs 60Hz) with Guidant — TQ-001	Sifab (Sondre)	HIGH
5	Request Honeywell confirm system 6C coating feasibility for SVP085	Sifab → Honeywell	HIGH
6	Include modular split concept drawing in Honeywell deliverables list	Sifab (quote)	HIGH
7	Consider Intertek partnership for offshore re-assembly	Sifab (Tom)	MEDIUM
8	Specify all SS 316 material grades explicitly in every BOM item	Sifab (engineering)	MEDIUM
9	Plan SIFAB engineer presence at 50% factory completion	Sifab (Oliver)	MEDIUM
10	Include seal replacement kit in spare parts if storage > 2 years	Sifab (quote)	MEDIUM
11	Verify US tariff implications on Honeywell pricing	Sifab (Sondre)	MEDIUM
12	Pre-fabricate all SIFAB-scope items (thermowells, JBs, cable glands) as a kit	Sifab (engineering)	MEDIUM
13	Build 4-week delivery schedule buffer to avoid expediting costs	Sifab (PM)	LOW
14	Request tag marking schedule from Guidant early in project	Sifab (PM)	LOW