

SwRI Oil & Gas Lecture Series

Methane Emissions, Managing Performance and Emissions

Siemens Energy

18 April 2023

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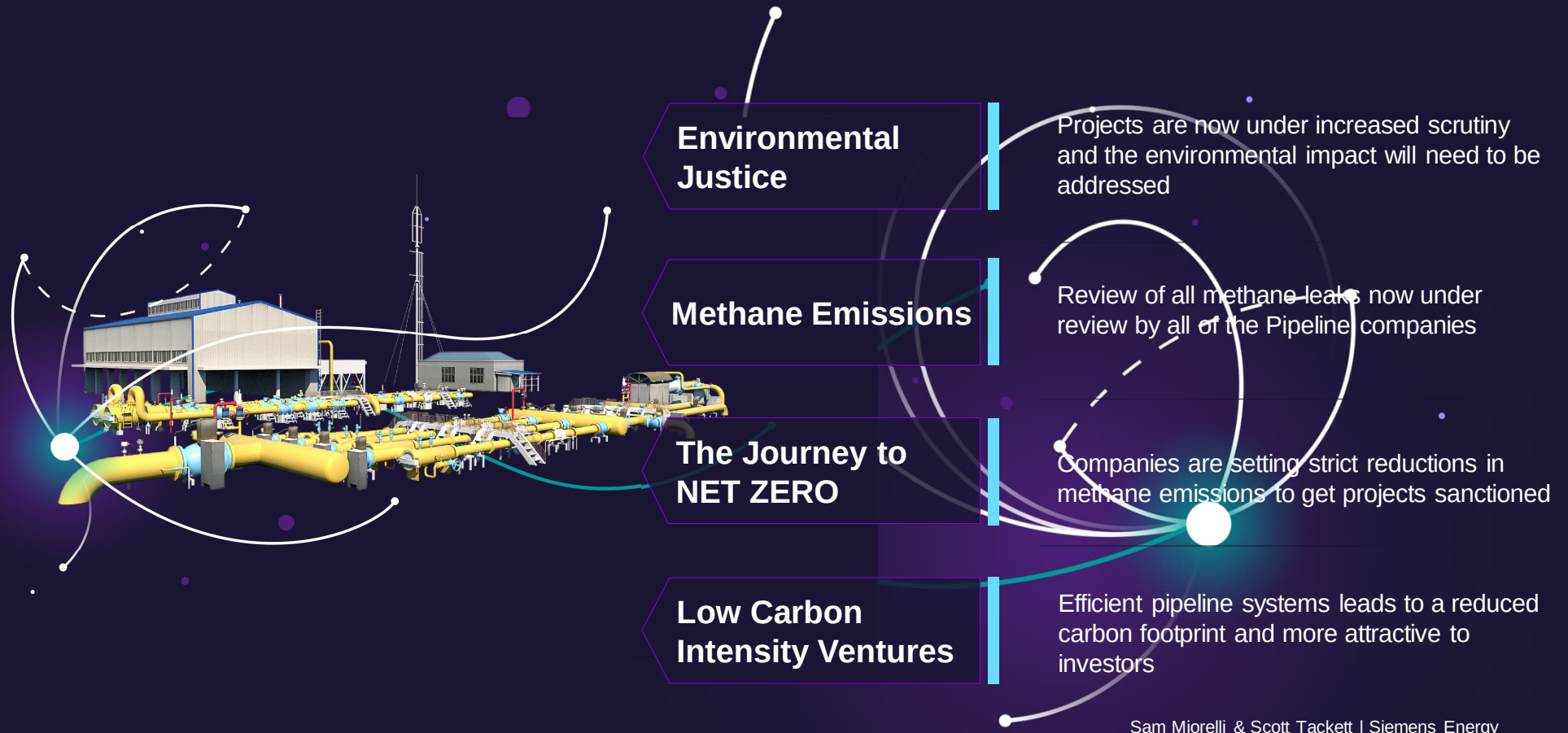
Agenda - Table of Contents

- 1** Managing Performance (Regulations)
- 2** Emissions (Reductions)
- 3** Emissions (Elimination / Capture)
- 4** Question / Answer Session



Oil and Gas companies are under pressure to go reduce methane emissions

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Managing Performance



Extract from US Methane Emissions Reduction Action Plan

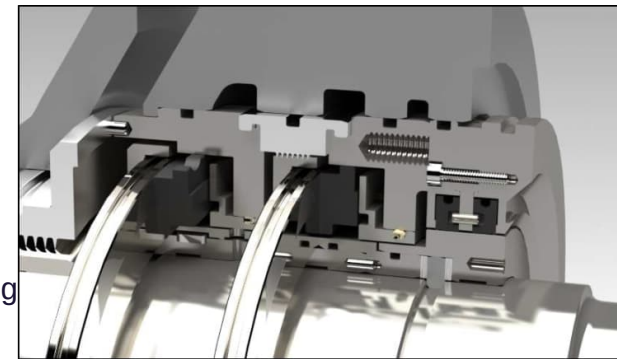
- The Department of the Interior is focusing on opportunities to tackle the venting and flaring of methane from oil and gas operations and well closures on public lands and waters

European Union Methane Strategy

- Improved measurement, reporting and verification of energy sector methane emissions
- Immediate reduction of emissions through mandatory leak detection and repair and a ban on venting and flaring

Extract from DACG (Mexico)

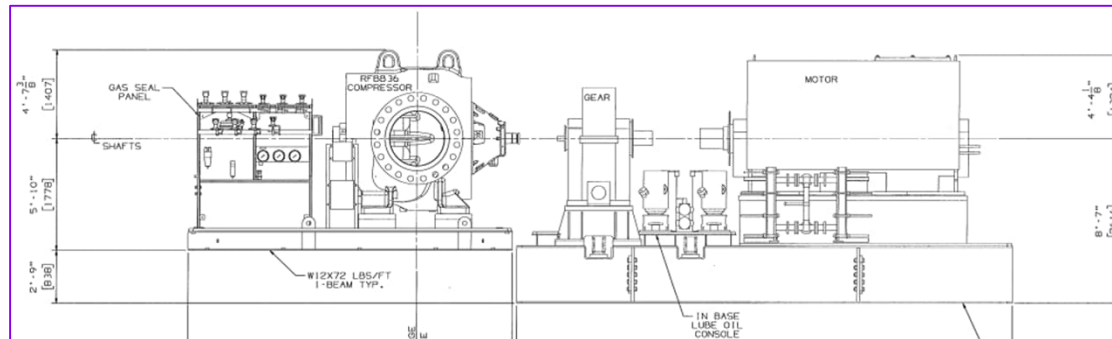
- Article 44 from the DOF– Replacing of Wet Seals or Capture the leakage.
- Article 46 from the DOF– Regulated parties must capture the gas from compressor purges (blowdown)
 - Primary: 'self-consumption or conservation'
 - Secondary: Gas is sent to a flare stack
- Article 53 from the DOF- Implement control measures even during maintenance / repair <5% total gas volume per year



Managing Performance

Summary of Regulations (per Compressor)

Region / Country	Pre 1 st Jan'23	Current
	SCFM / m3/Hr	SCFM / m3/Hr
Canada Federal	5.0 / 8.4	5.0 / 8.4
Alberta / BC/ Ontario	6.0 / 10.2	2.0 / 3.4
USA Federal	6.0 / 10.2	6.0 / 10.2
Globally	6.0 / 10.2	6.0 / 10.2



Typical Electric Motor driven Compressor (EMDC) Train



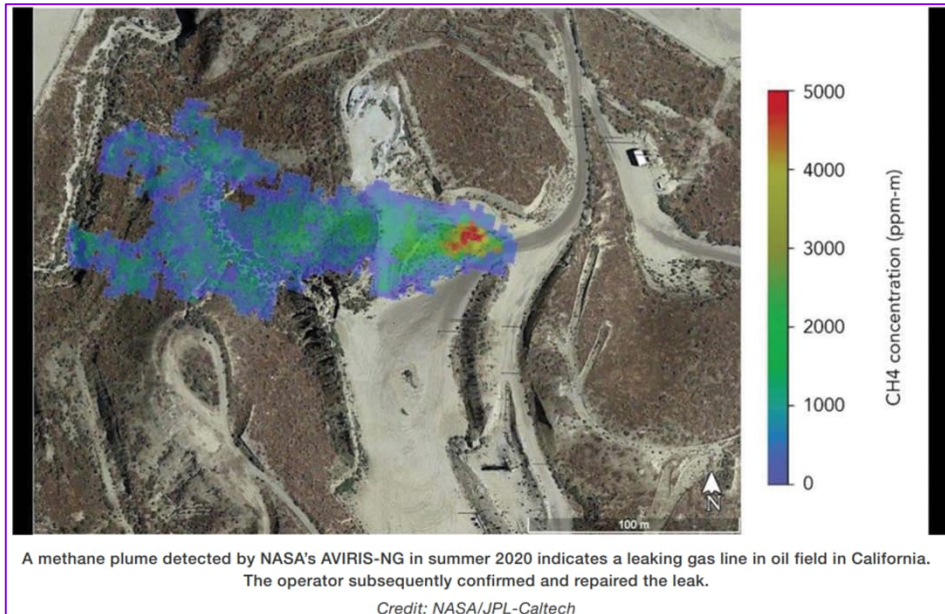
Typical Gas Turbine driven Compressor (GTC) Train

Strong focus on Greenhouse Gases from Organizations, Shareholders, Communities and Regulatory Authorities

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Managing Performance



Source: US Methane Reduction Action Plan

Reduction of Fugitive Emissions

- Replacing old installed hardware with current technology
- Preventive Maintenance
- Leak Detection and Repair (LDAR)
- Compressor and DGS Selection

Capture / Elimination of Fugitive Emissions

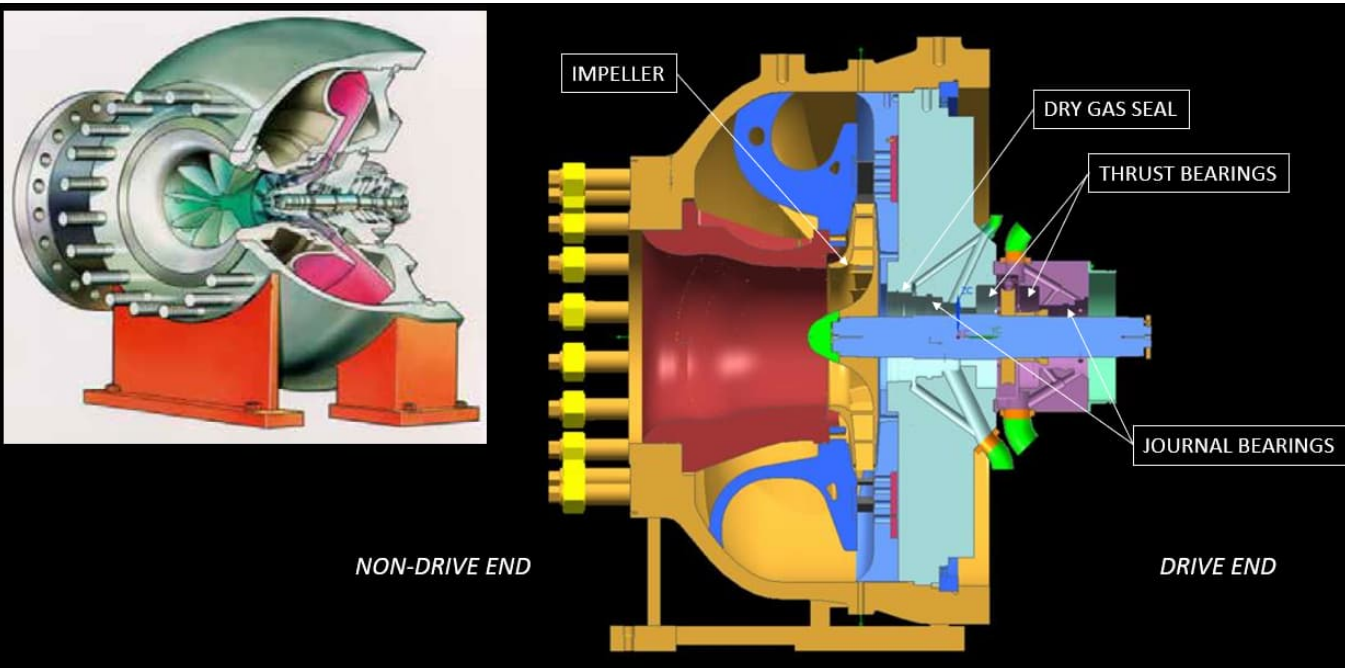
- Re-injection into Turbomachinery
- Burn the Greenhouse Gas
- Capture & Recompression

Client Needs

- Primary Seal Gas leakage focused
- Motor or Gas Turbine Drivers
- Scalable
- Normal Operation
- Shutdown (Pressurized / Vented)
- Re-injection (Suction/Discharge/Alternate)
- Maintenance
- Redundancy
- Life Cycle Costs
- Brownfield Installations
- OEM Neutral

Emissions - Reduction

Siemens Energy Axial Compressors



RFA24 / RFA36

- One Dry Gas Seal for Axial Inlet Vs Beam Style Compressor.
- Guaranteed Primary Seal Leakage can be as low as 1-1.5 SCFM
- High Efficiency Compressor
- Movable Inlet Guide Vanes capable
- Seal Gas leakage has a direct impact on recompression offering:
 - More leakage = More compression required

RFA36 Cross Section

Emissions - Reduction

Siemens Energy Dry Gas Seals



- Reduce the amount of Primary Vent leakage to atmosphere.
- In-house Technology: Engineering, Production, Services.
- 25+ Years of Experience / 30M+ Operating Hours
- API 692 Complaint
- Standard offering on New Equipment Solution.
- Ability to retrofit existing Installed Base – Dry or Wet Seals



Siemens Energy DGS on Test Stand

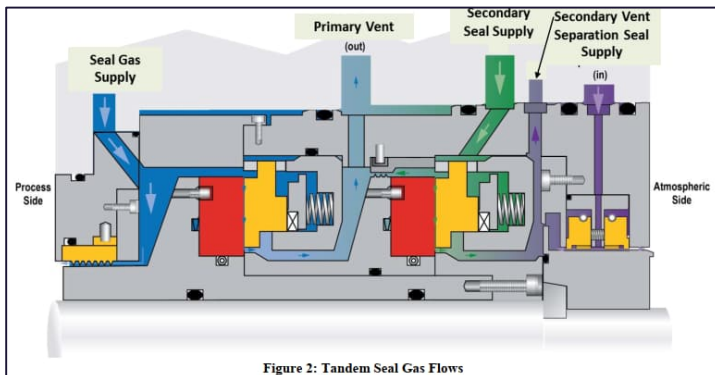


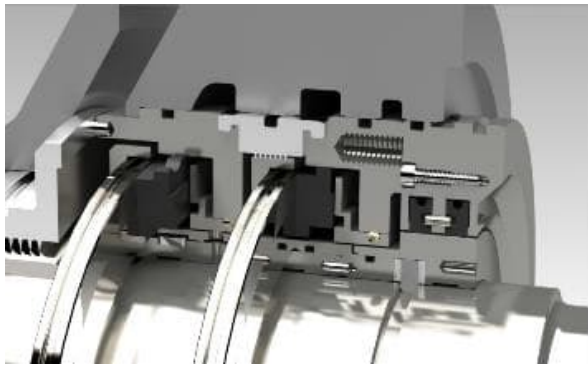
Figure 2: Tandem Seal Gas Flows

Courtesy: TAMU

Typically, in Midstream Duty, there is no Secondary Seal Supply. Port is Blanked. Emissions can be further reduced if Customers use Inert Gas (like Nitrogen) as Secondary Seal Supply.

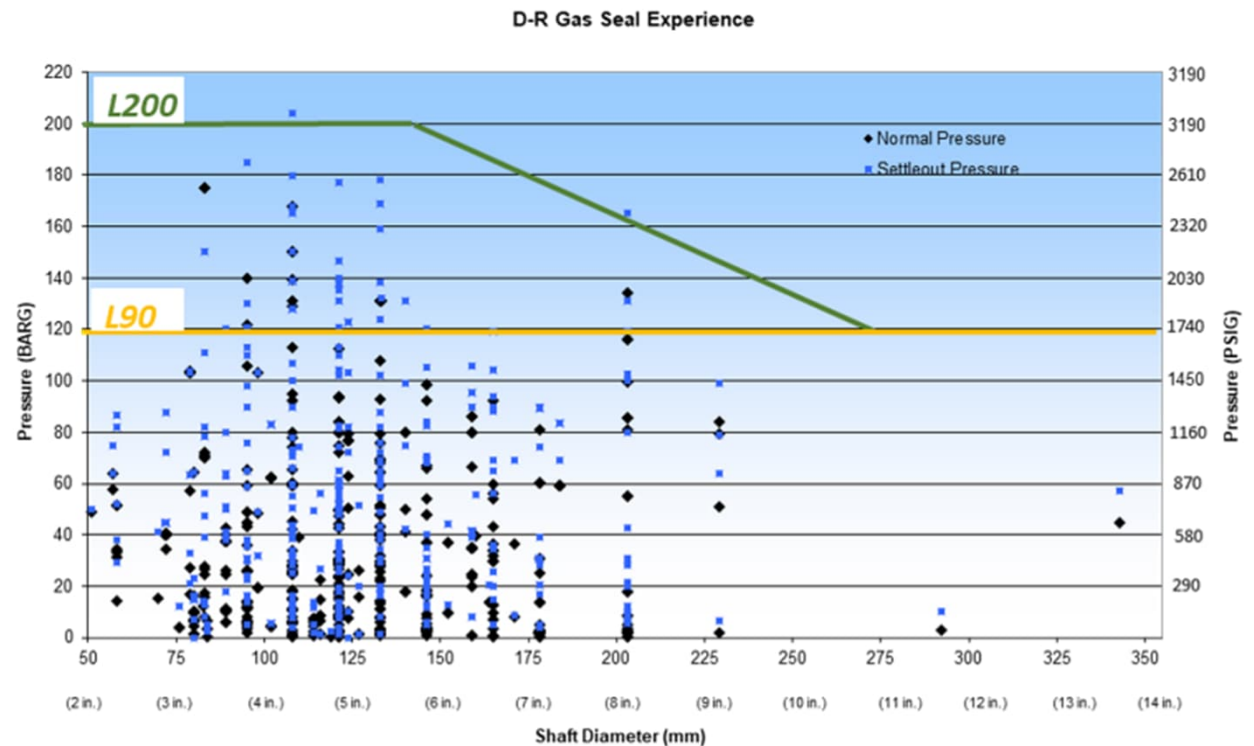
Methane Emissions - Reduction

Siemens Energy Dry Gas Seal – Standard Spec or High Spec



Standard configuration*

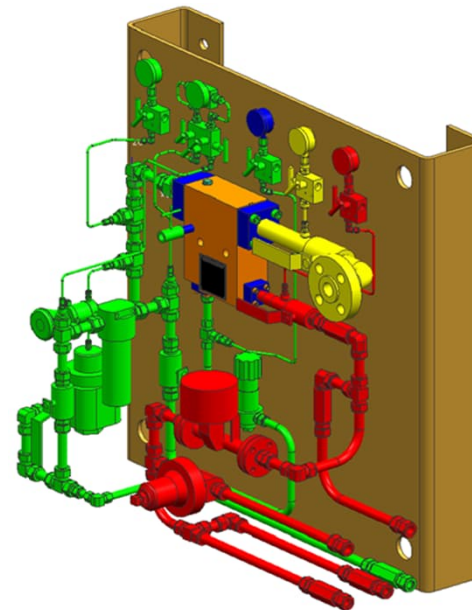
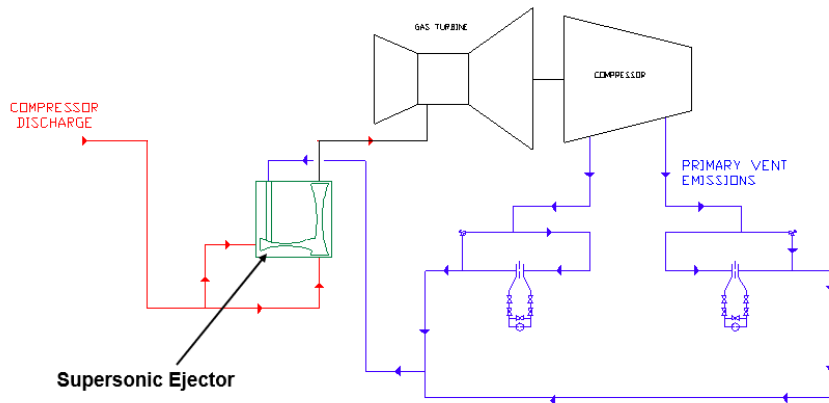
- To 3190 PSIG
- 17,000 rpm
- 356 F
- To 11.5 in
- Minimized hang-up



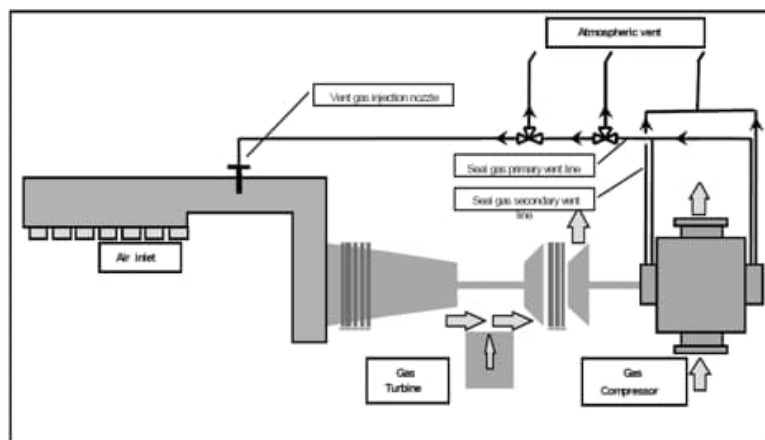
Methane Emissions – Capture Supersonic Ejector



- Supersonic Ejector solution for fugitive emissions will ensure compliance with current and future regulations.
- Siemens solution is designed for new equipment as well as existing equipment with a GT driver.
- Solution scalable to accommodate 1 to 15 SCFM primary vent seal leakage.
- Designed for compressor normal operation.
- Pre-configured to re-inject into a heater inlet, fuel system inlet or alternate gas supply.
- Few moving parts so low maintenance solution
- Low Cost initial investment



Emissions – Capture Gas Turbine Inlet Reinjection



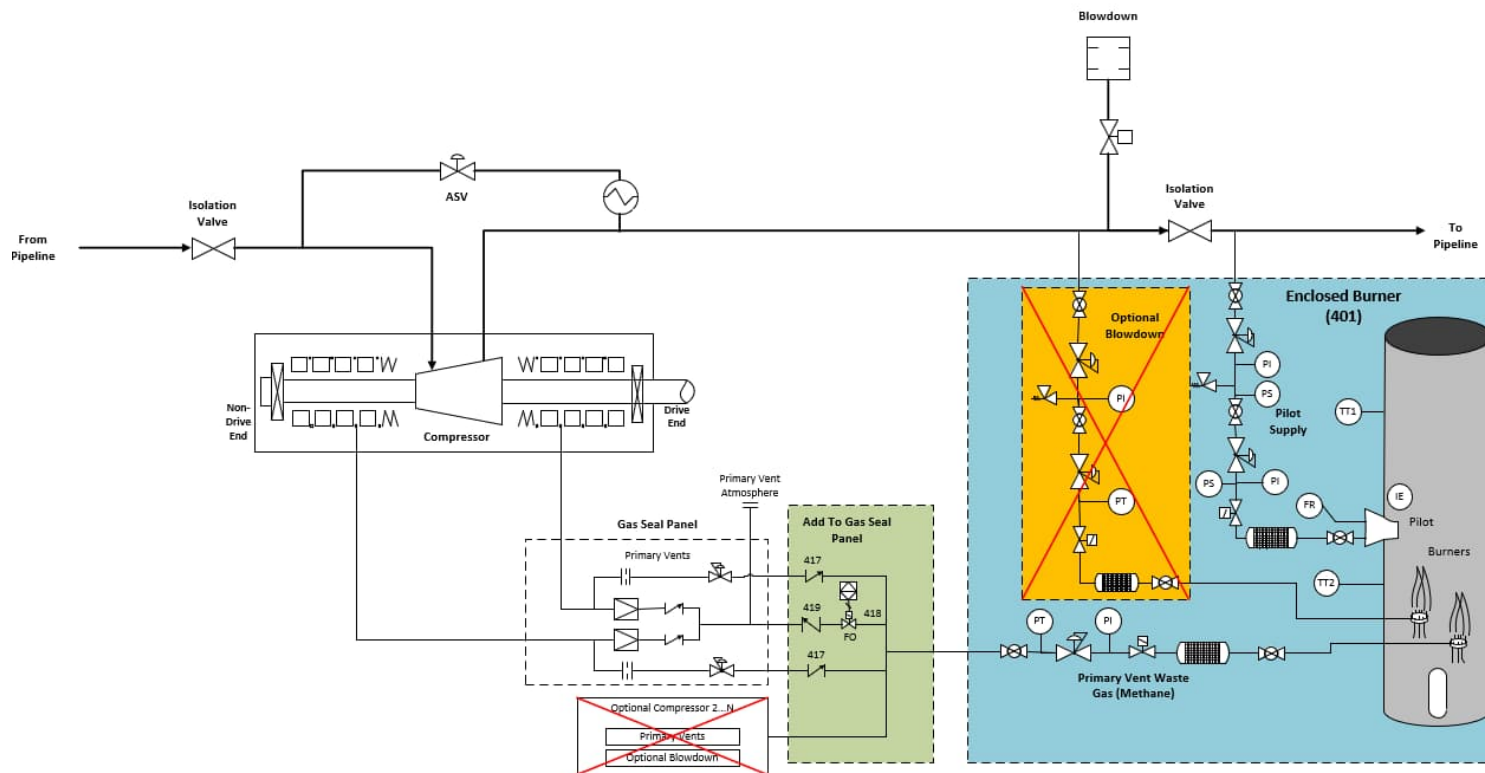
Compressor	Gas Turbine
RFBB20, RFA24, RFBB24	SGT-100 / SGT-300 / SGT-400
RFBB30, RFBB36, RFA36, RFBB42	SGT-A35 SGT-600, SGT-700, SGT-750

Technology	Pros	Cons
GT Inlet Reinjection	• Re-inject to inlet of GT • Low Maintenance • Easy implementation	• GT supplier approval • Client approval • Compressor Settle-out • Compressor Blowdown

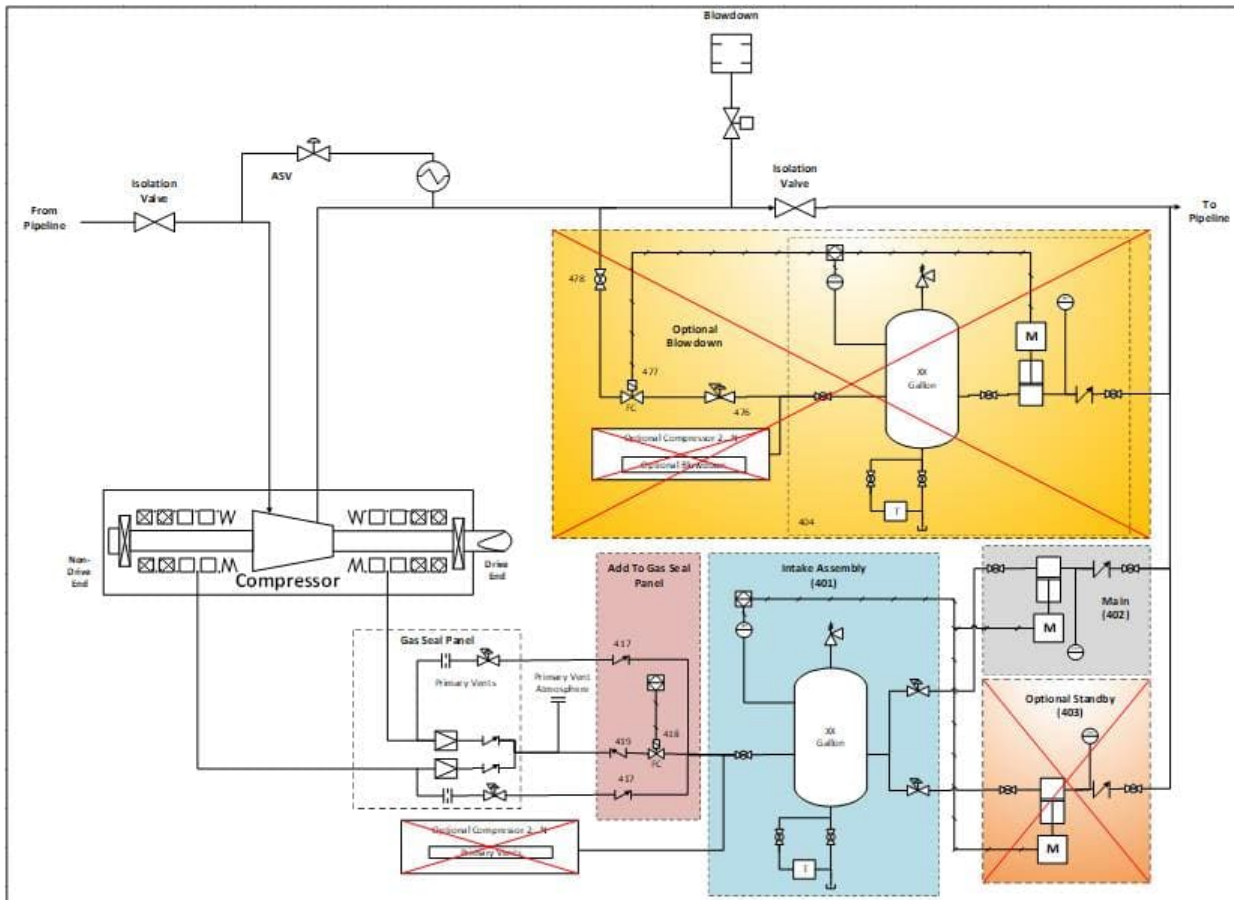
Based on a GT inlet flow of 80 kg/sec (using a bit below full power), the mix will be very lean, only around 0.007 %, thus below flammability limits.

Emissions – Capture Enclosed Burner

Suitable for Primary vent waste gas and/or compressor blowdown



Emissions – Capture Recompression



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Baseline Solution:

- Recompress the DGS leakage into Process Pipe.
- Reciprocating Compressor
- ASME / Class 1 Div. 2 rated.
- ~1-hour initial charge time, 30 minutes On / 30 Off.

For Discussion:

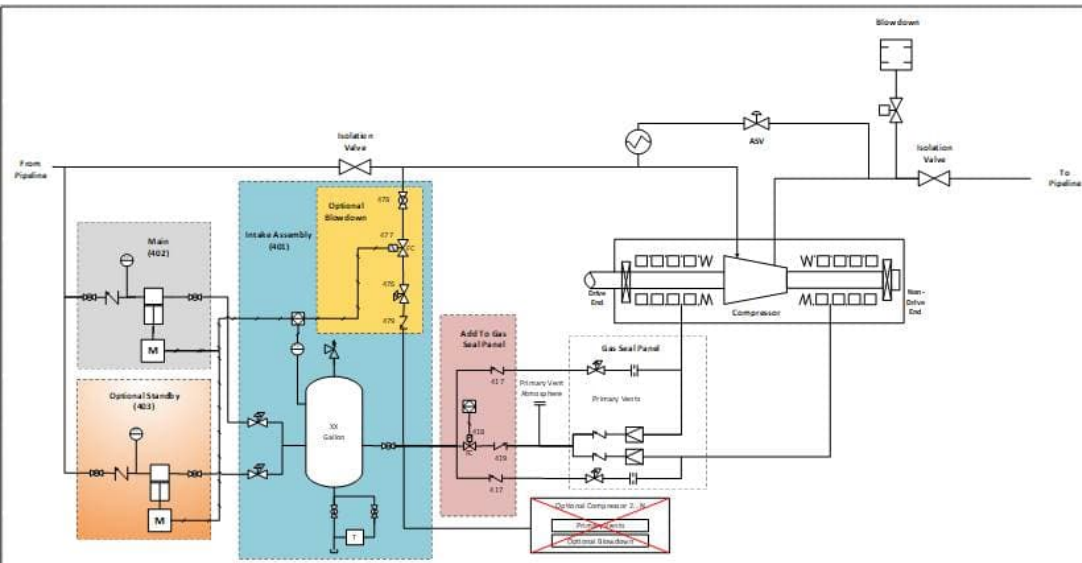
- Blowdown requirements (Volume and Time)
- Suction or Discharge Process Pipe
- One system for multiple Trains
- Redundant System

Direct impact on Compressor / Receiver Tank sizing

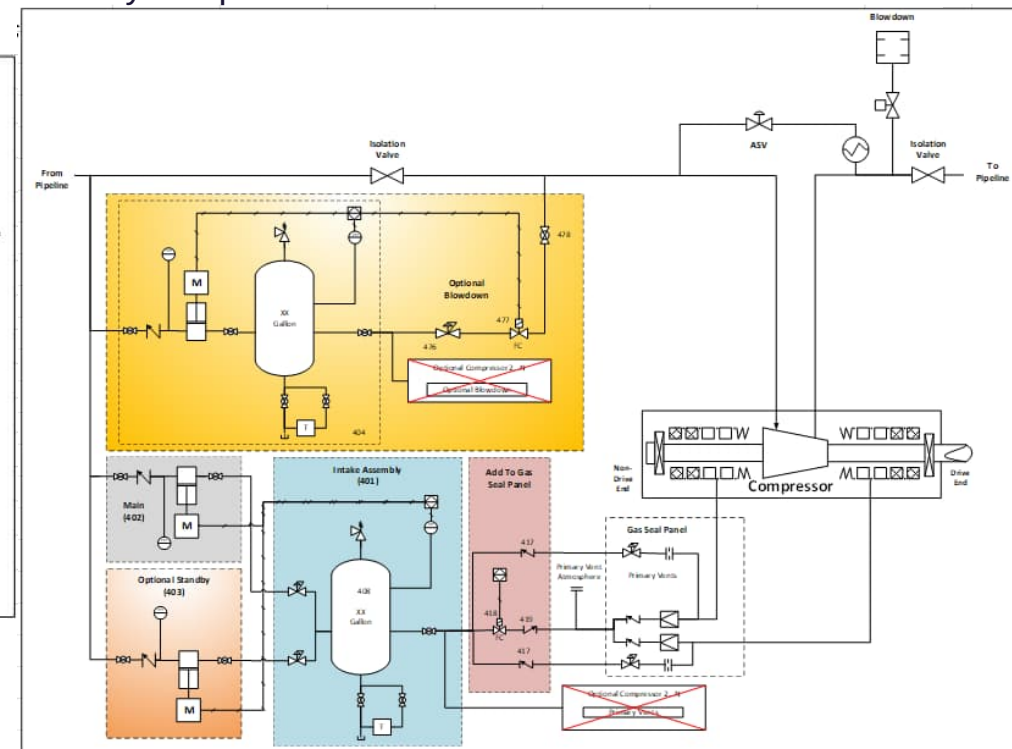
Emissions – Capture Recompression



Leakage gas to pipeline suction with integrated blowdown,
standby compressor



Leakage gas to pipeline suction with separate blowdown,
standby compressor



Methane Emissions - Various Solutions



Reduction

(Solution 1) – Siemens Energy RFA Compressor

(Solution 2) – Siemens Energy Dry Gas Seals

Capture

(Solution 3) Supersonic Ejector

(Solution 4) Gas Turbine Inlet

(Solution 5) Enclosed burner

(Solution 6) Re-compression

Criteria	Supersonic Ejector	GT Inlet	Enclosed Burner	Re-compression
Gas Turbine Driver	X	X	X	X
Electric Motor Driver			X	X
Scalable			X	X
Normal Operation	X	X	X	X
Shutdown Pressurized			X	X
Shutdown Vented			X	X
Shutdown ESD				
Re-injection into Suction	X			X
Re-injection into Discharge				X
Re-injection into alternate gas supply	X			X
Vent to atmosphere		X	X	

Thanks for your attention. Questions?

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