

Balance of Plant Panel Session

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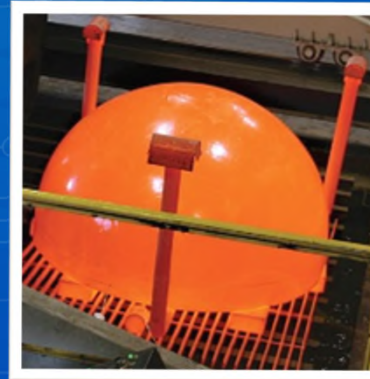
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Alvin Pressure Hull

Pluto from New Horizons Spacecraft



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SwRI's Roles in the STEP Pilot Plant Project

- The STEP Demo is a project funded by DOE NETL and led by GTI Energy in partnership with SwRI and GE Vernova Advanced Research
 - 10 MWe sCO₂ Pilot Plant,
 - TRL3 to TRL7
- SwRI Roles:
 - Host site
 - System integration and operation
 - Data acquisition & controls
 - Piping
 - Inventory Management System (IMS)
 - Turbine design & fabrication (with GE)
 - Heater protection valve (HPV)
- Simple Cycle testing completed October 2024
- RCBC Reconfiguration in final stages of construction



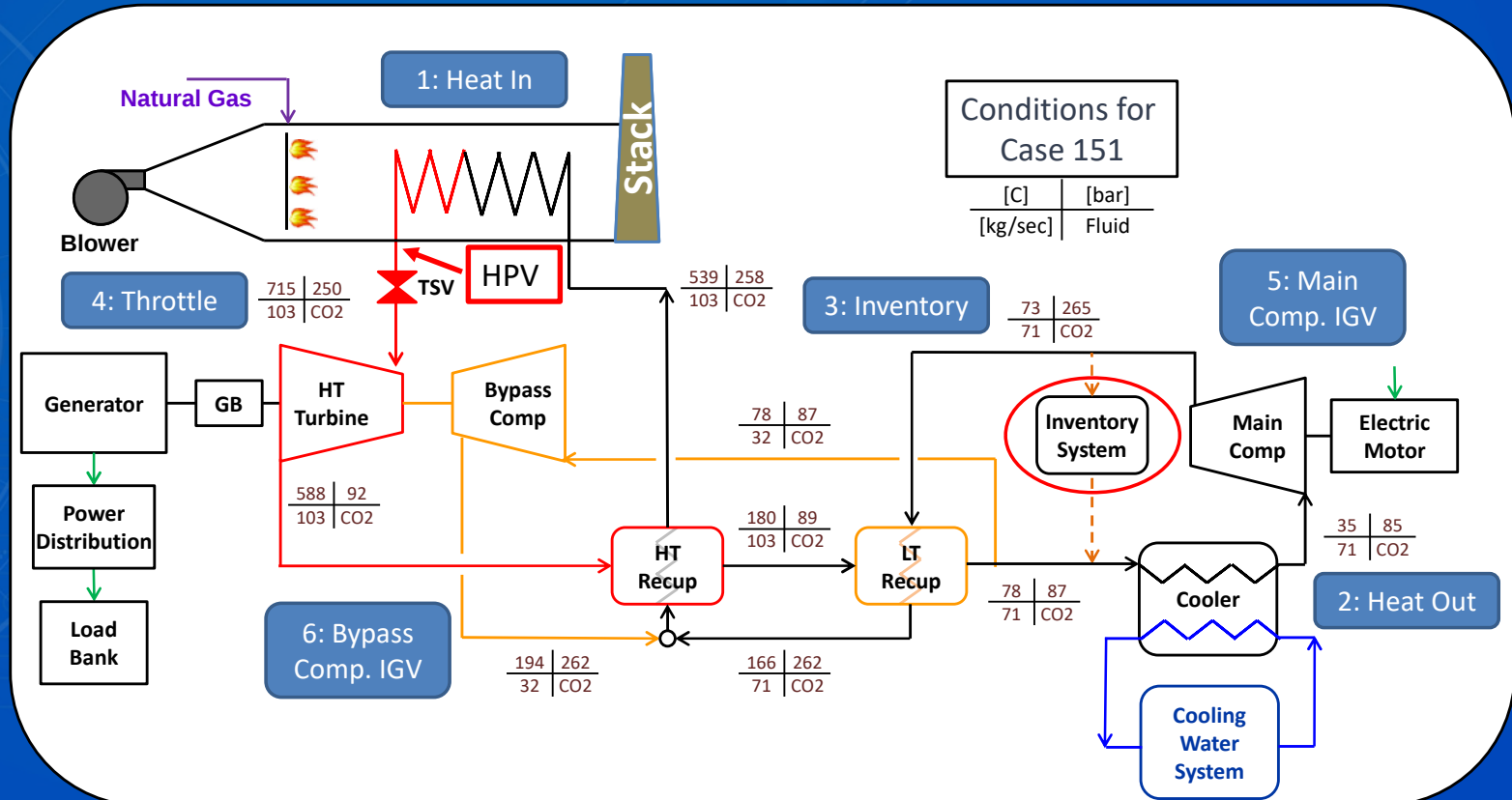
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Recompression Closed Brayton Cycle

Objectives

- **High performance** cycle configuration
- Turbine inlet up to **715°C**
- **Parallel compressors** with different head curves
- Multiple Heat Exchangers
- **Measure** system and component **performance**
- Evaluate operability
- Demonstrate **pathway to 50% thermal efficiency**



Why have an IMS?

- Controls the amount of CO₂ in the system (which affects system load)
- Responsible for initial fill of system
- Supports Auxiliary systems like Dry Gas Seals (DGS)
- Can enable fast transitions between load points

Model Names	Cycle Configuration	Description	Load %	Net Power Level (MWe)	Cooler Exit Temperature	Turbine Inlet Temperature	Cycle Efficiency
133	Simple	Simple cycle minimum load case	Min	2.5	35°C	500°C	22.6%
136	Simple	Simple cycle maximum load case	Max	6.4	35°C	500°C	28.3%
151	Recompression	Baseline case	100%	10.0	35°C	715°C	43.4%
152	Recompression	"Hot" Day Case	70%	6.6	50°C	675°C	37.4%
153	Recompression	"Cold" Day Case	100%	9.9	20°C	525°C	36.8%
154	Recompression	Partial load case using inventory control	40%	4.0	35°C	715°C	37.0%
155	Recompression	RCBC at 500°C turbine inlet temperature	70%	6.9	35°C	500°C	32.5%
157	Recompression	Partial load case using TSV throttling (transient condition)	40%	4.2	35°C	715°C	30.8%
157a	Recompression	Partial load case using TSV throttling	40%	3.9	35°C	675°C	29.6%



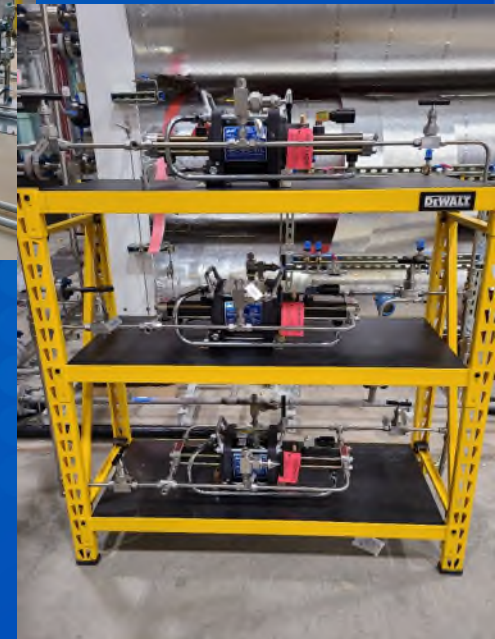
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STEP Inventory Management System

- 30 ton liquid CO₂ storage tank
- 2 VFD powered reciprocating pumps
- 2 electric vaporizers
- 6 indoor storage tanks
- DGS air driven boost pumps
- DGS buffer tank
- Heat trace
- Valves
- Lots and lots of tubing and fittings...



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STEP Heater Protection Valve

- Multi-purpose valve
 - Controlled venting (% open control)
 - Pressure Relief Safety Valve
- Challenging design
 - Rated for 715°C, 250 bar venting direct to atmosphere
 - High risk of damage due to thermal cycling



Gratefully Acknowledging the Support from U.S. DOE-NETL and Project Partners



www.STEPdemo.us

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