Abstract for Show Guide

Compression systems are designed for the governing process conditions. In the Oil and Gas industry, these conditions are often dynamic and a function of reservoir or field characteristics which have varying head and flow rate requirements throughout the field life. The main application objective when designing a gas turbine driven centrifugal compression solution to suit these applications, is to maximize efficiency while minimizing the requirement for additional package modifications or major capital works in mid to late field life. This presentation shows how these objectives were achieved for a case example in South Sumatra, Indonesia where an onshore gas field, feeds a localized gas plant that requires front end compression.

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TURBOMACHINERY LABORATORY
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Solar Turbines
A Caterpillar Company

ConocoPhillips

Adapting compression equipment to accommodate declining well pressures and ensure overall efficiency in mid/late field life.

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Ben has spent the past 11 years working with turbomachinery throughout the world and is currently working for Solar Turbines with responsibility for Oil and Gas, business development within Indonesia. During his career he has worked in a diverse range of roles including field service, aftermarket support, applications engineering and business development. He holds a Bachelor of Electrical Engineering from RMIT University and has almost completed a Masters in Energy from The University of Queensland.

The Application

Future State

Inlet Compression

Gas Plant
South Sumatra - Indonesia

Export Compression

Declining well head pressure, drives the requirement for front end compression to maintain plant operation and maximum gas export

The Problem

How do you select turbomachinery equipment for the following conditions?

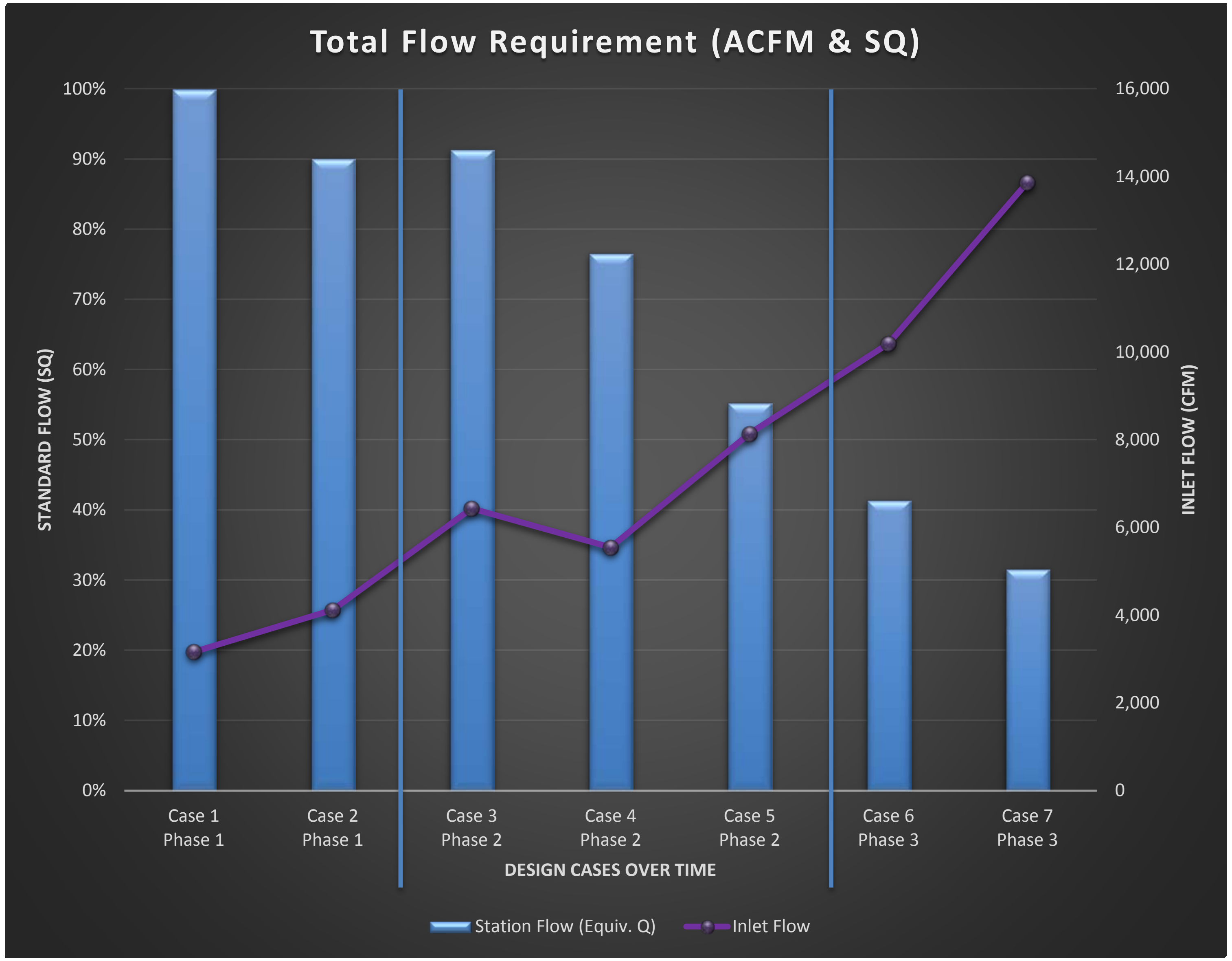
PARAMETER	UNITS	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Time Period		24 to 36 Months		24 to 36 Months			60 Months	
Suction Pressure (P1)	[psia]	800	575	385	375	190	115	65
Suction Temperature (T1)	[°F]	119	119	119	119	119	119	119
Discharge Pressure (P2)	[psia]	1315	1315	1315	1315	1315	1315	1315
Station Flow (Equiv. Q)	%	100%	90%	91%	77%	55%	41%	32%
Inlet Flow	[cfm]	3165	4120	6435	5546	8138	10196	13868
Head (isen)	[ft·lbf/lbm]	16929	30318	48462	49719	84806	113850	150063
Gas Composition	SG	0.847	0.847	0.847	0.847	0.847	0.847	0.847

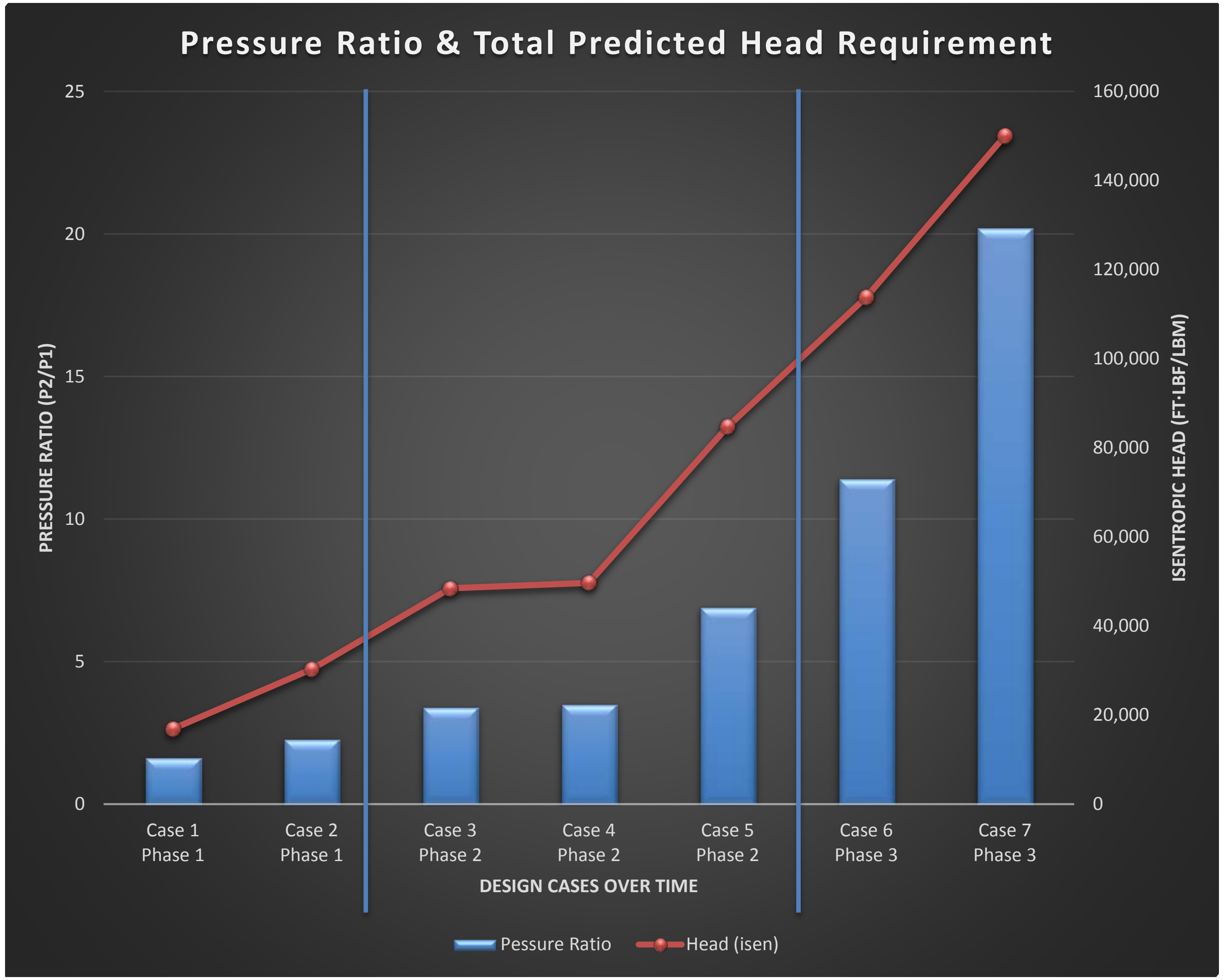
Main Objectives/Considerations:

Maximize Efficiency
Cost (CAPEX & OPEX)
Constructability / Remote Location

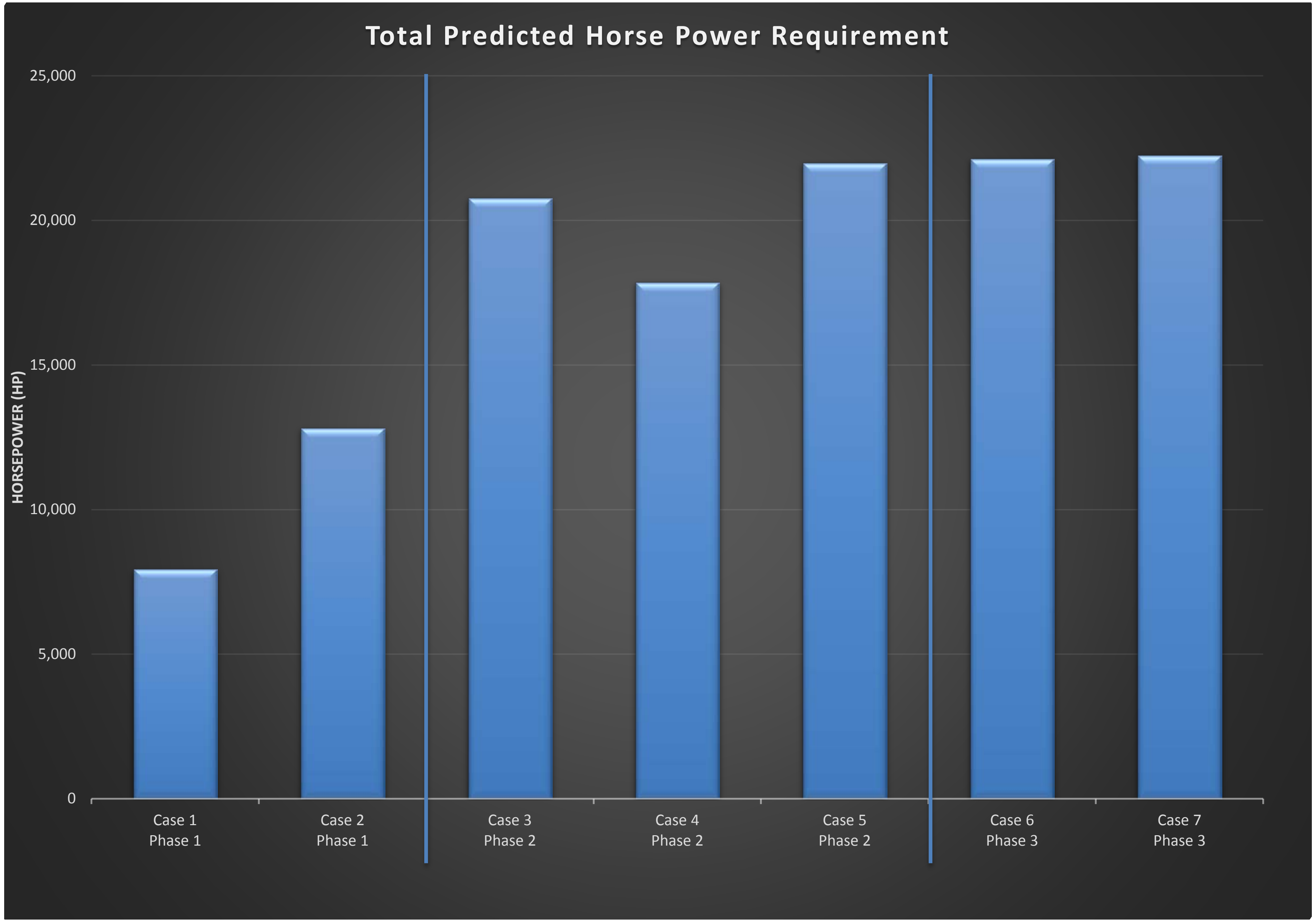
Minimize Onsite Rework
High Reliability and Availability
Maximize Output/Production

Compression Selection Considerations





- Total Power Required
- Package Configuration
- Redundancy
- Turndown
- Fuel Efficiency
- Power Margin
- Performance Degradation
- Emission Requirements
- Speed Range
- Combustion System



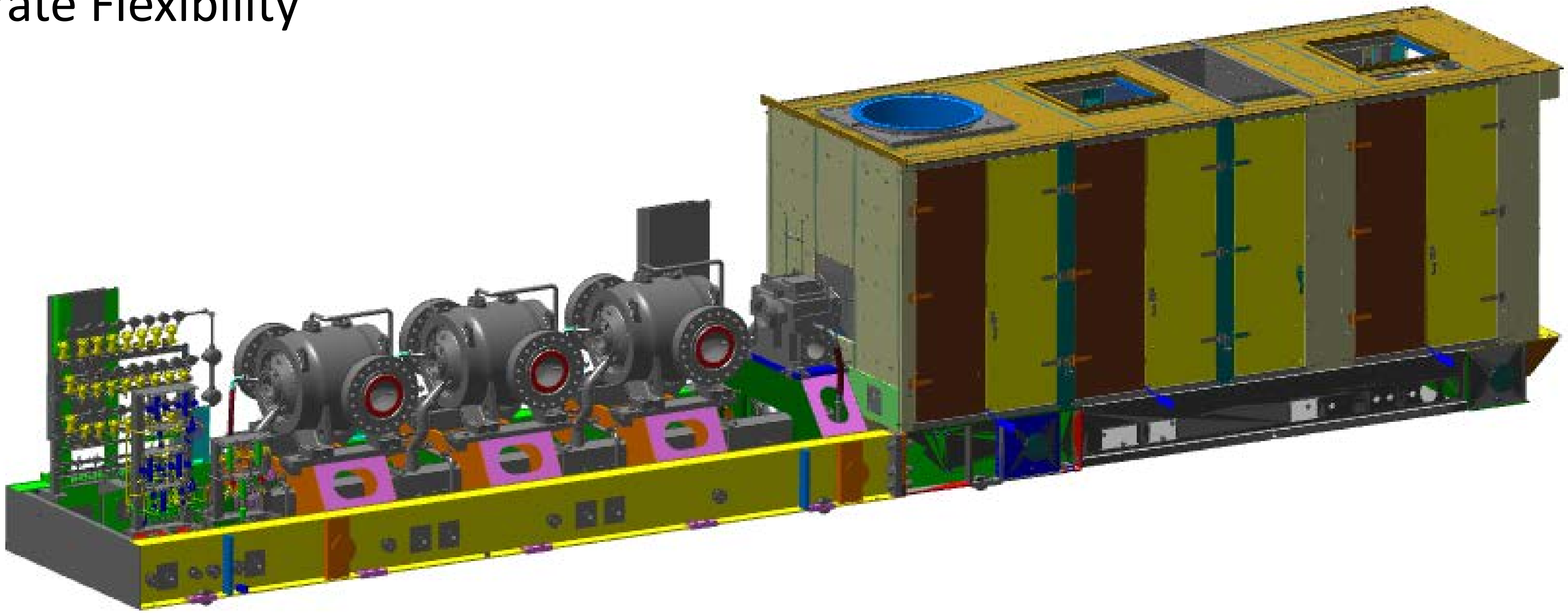
The Solution

- 3 x Package Configuration
- Gas Turbine – 10,300 HP (ISO)
- Speed Increasing Gearbox
- Expandable Multi Body Compression System
- Flexible Process Cooler & Plant
- Late Life Rerate Flexibility

Phase One: Gas Turbine - GB - LP

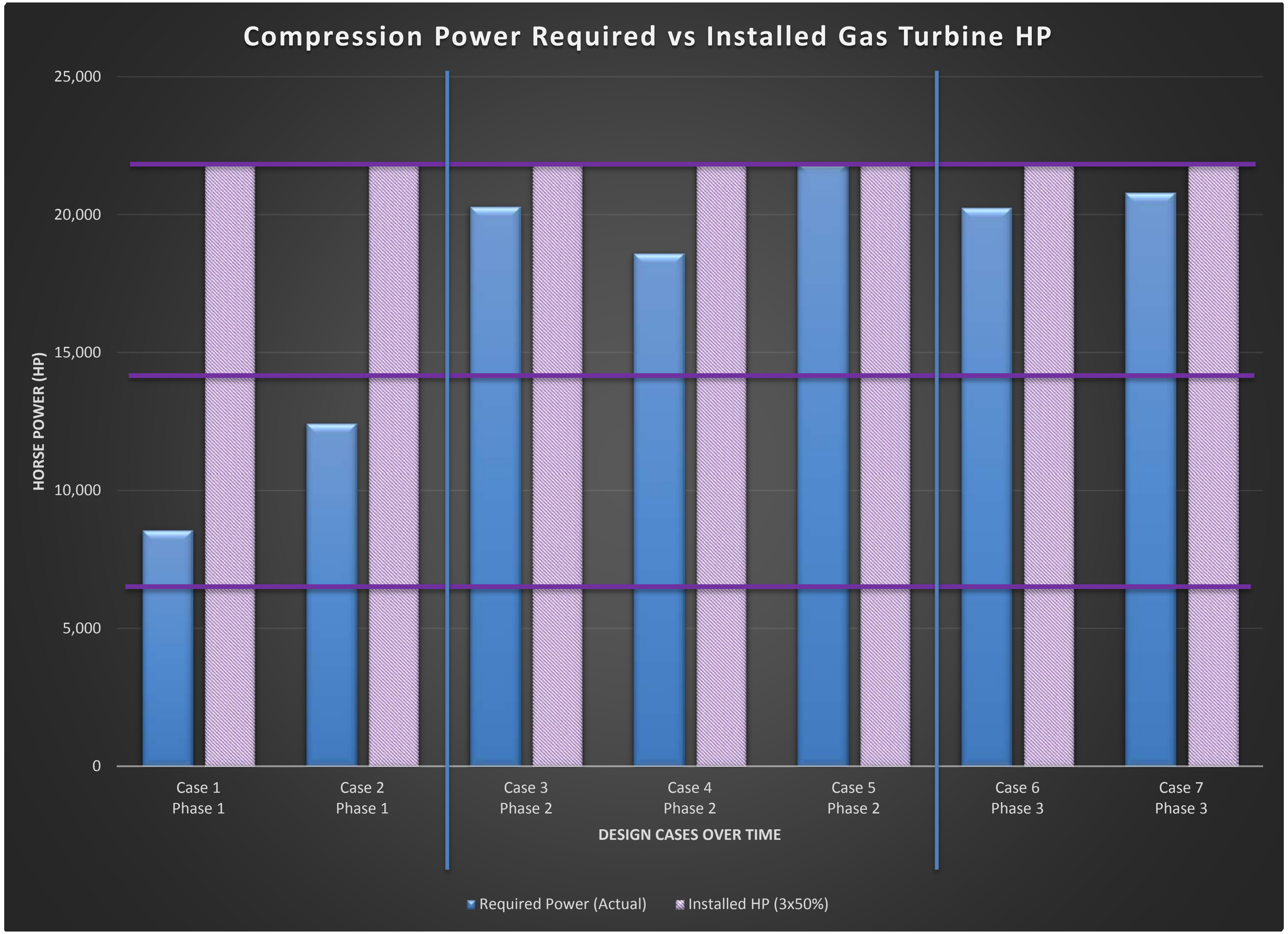
Phase Two: Gas Turbine - GB - LP - IP

Phase Three: Gas Turbine - GB - LP - IP - HP



Gas Turbine Sizing Methodology

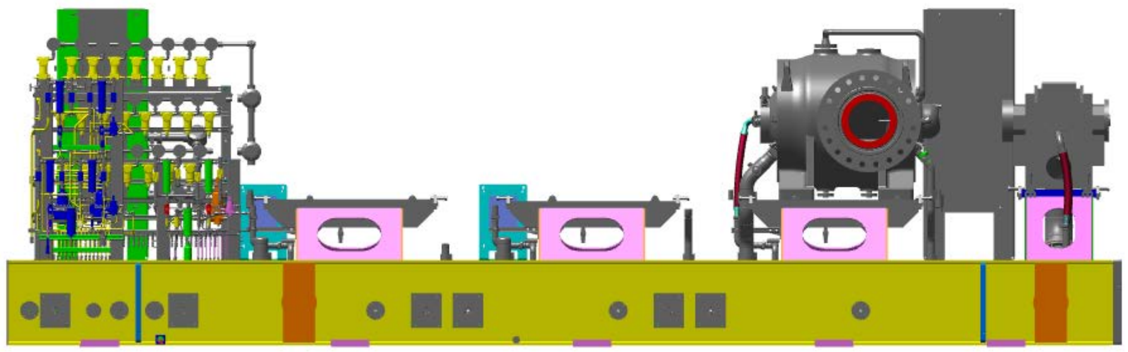
- Gas Turbine - 10,300 HP (ISO)
- 3 x Package Configuration
  - Phase 1 – 3 x 50% Operation
  - Phase 2 – 3 x 33% Operation
  - Phase 3 – 3 x 33% Operation
- Adequate Power Margin
- High Part Load Efficiency
- Uprate Option during O/H Cycle
- Engine Commonality in Fleet
- Compliant Emissions

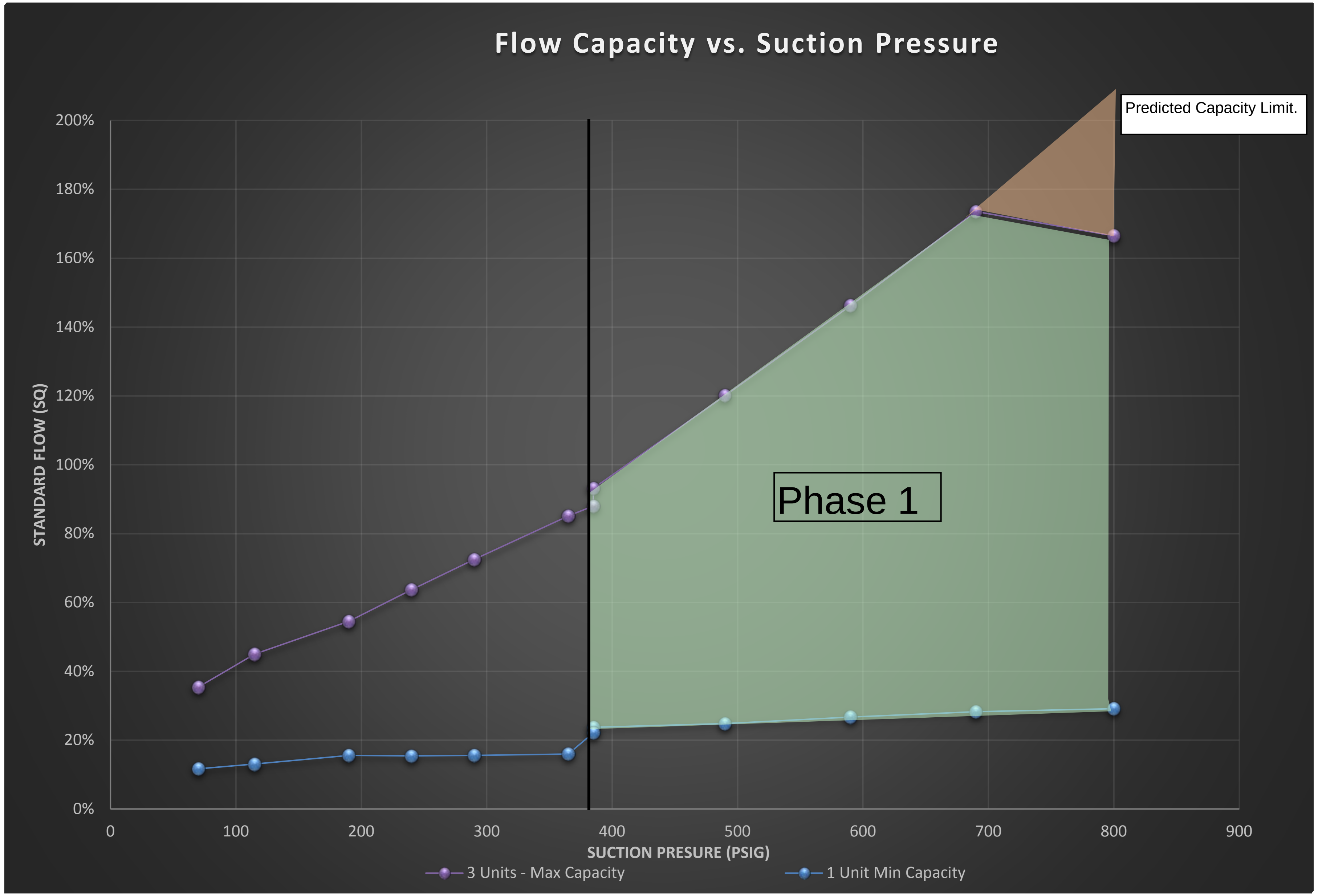


Compression System

Phase One:

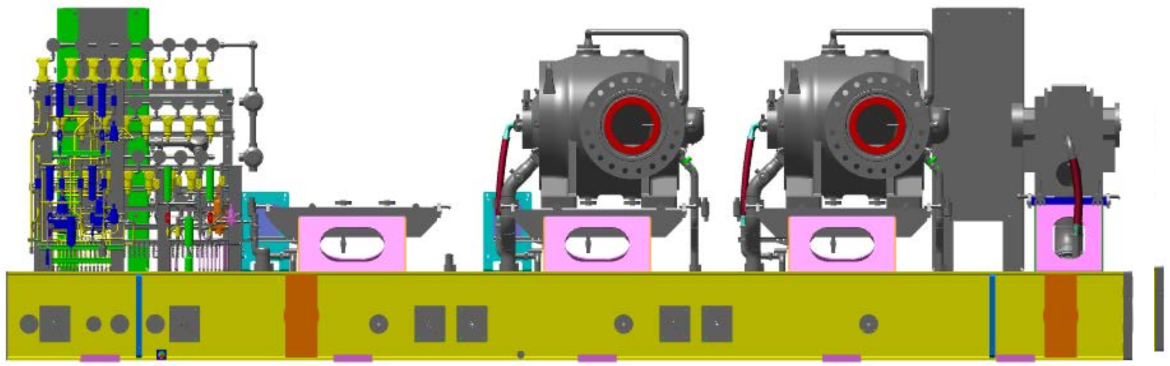
- 3 x 50% Operation
- Gas Turbine – GB – LP
- Discharge Pressure: 1315 PSIG
- Suspection Pressure: 800 - 385 PSIG

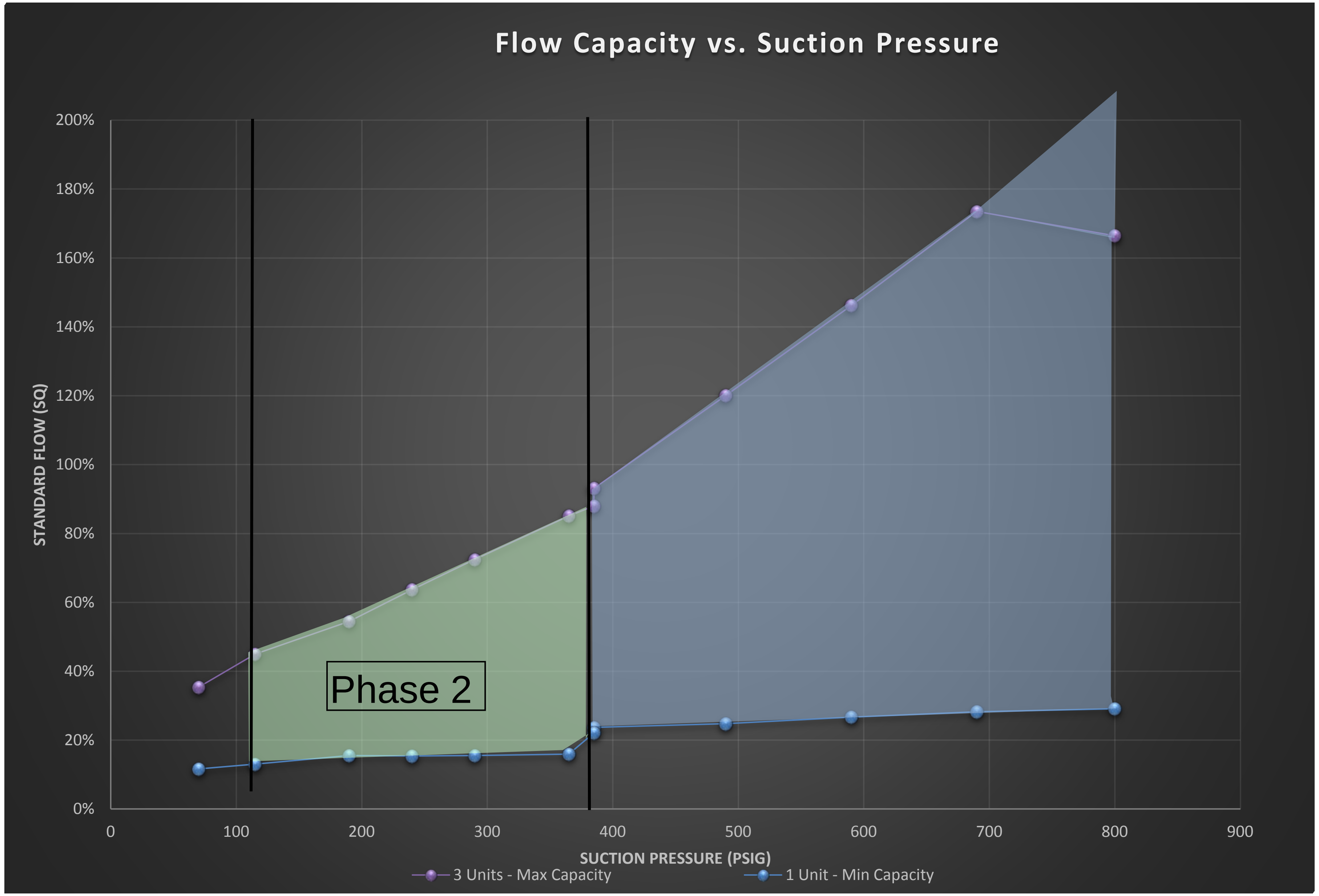




Phase Two:

- 3 x 33% Operation
- Gas Turbine – GB – LP - HP
- Discharge Pressure: 1315 PSIG
- Suction Pressure: 385 - 110 PSIG

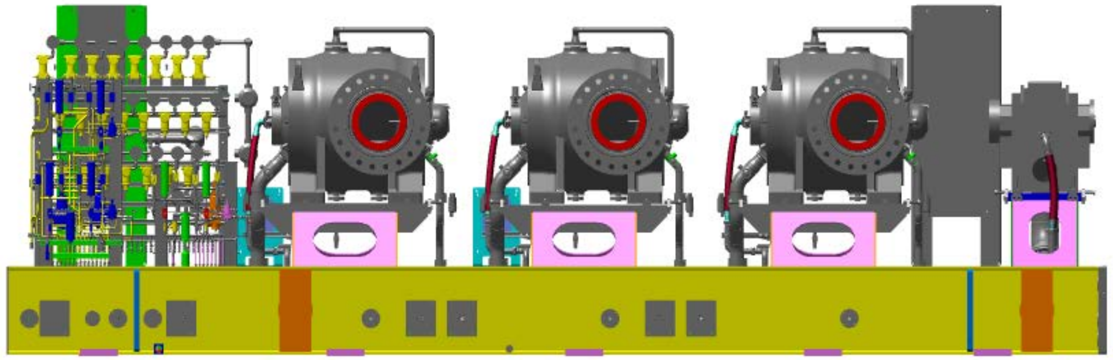


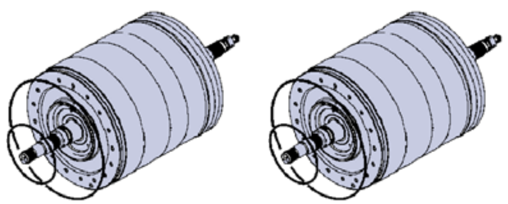


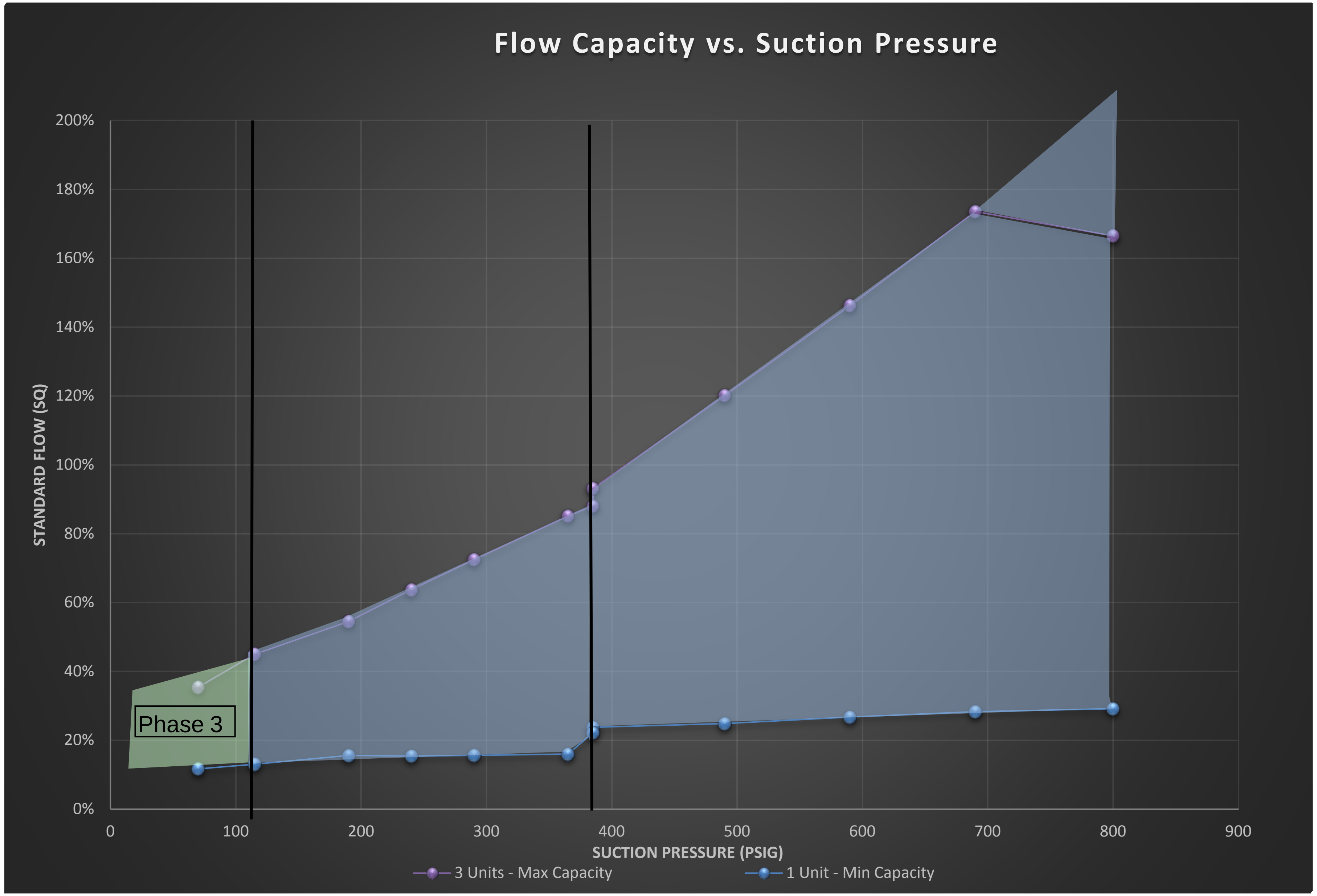
Compression System

Phase Three:

- 3 x 33% Operation
- Gas Turbine – GB – LP – IP – HP
- LP & IP Compressors Restaged
- Discharge Pressure: 1315 PSIG
- Suction Pressure: 110 - < 70 PSIG

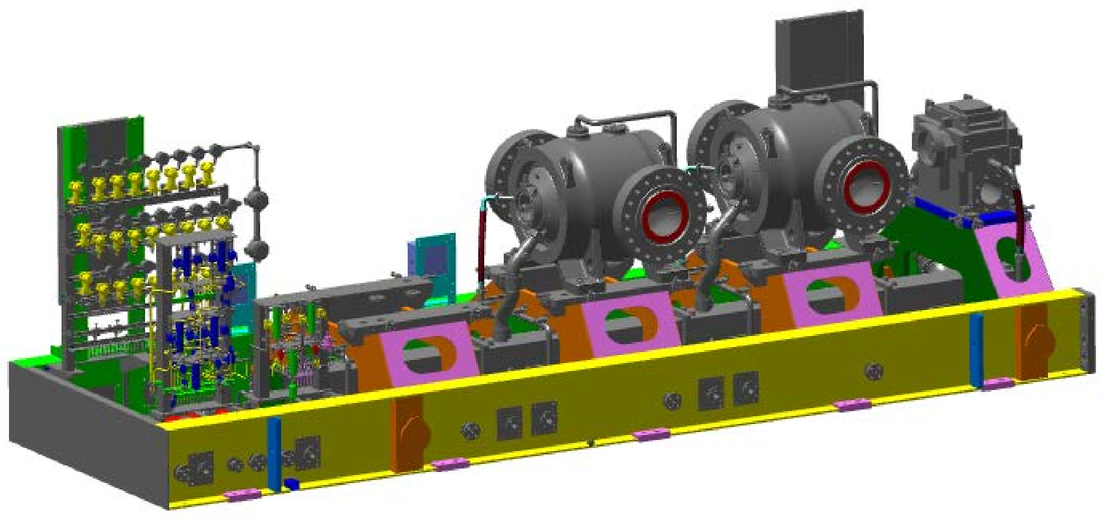


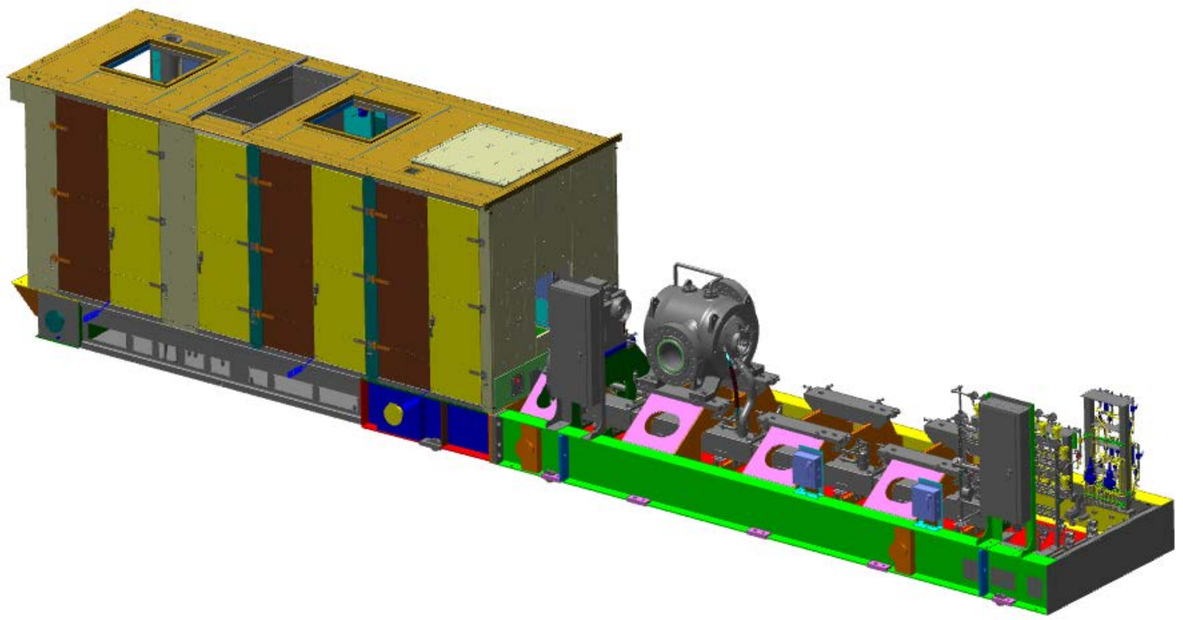




Package Configuration

- Complete package designed, manufactured and tested by single OEM
- IP and HP compressor package systems including lube oil piping, seal gas, wiring and instrumentation preinstalled and tested ready for activation during Phase 2 & 3
- Isolation and preservation measures implement for inactive components on Phase 1
- CAPEX for IP and HP compressors deferred until Phase 2 & 3
- Preconfigured package control software designed, tested and preloaded for all Phases
- Surge control system preconfigured for all Phases





Balance of Plant

-Process cooler designed for maximum cooling load with turndown capability for Phase 1 & 2
-Process piping designed with manifold and tie in points for Phase 2 & 3
-Yard valve selected to operate under full range of operating conditions
- Initial suction scrubber installation suitable for all Phases

Conclusion

3 x Package Configuration

- Provided better efficiency, turn down and operability throughout field life.
- Achieved redundancy and availability objectives for contract output requirements
- Package size met constructability requirements and drove common configuration with existing fleet

Preconfigured Package and Addition of Compressor Bodies for Each Phase

- Greater overall field life efficiency and operating flexibility
- Flexibility on timing of transition to Phase 2 & 3
- Deferred CAPEX for procurement of IP & HP compressors
- Reduced downtime during conversion to Phase 2 & 3

Preconfigured Plant Design

- Adaptable to compression system with minimum downtime during conversion to Phase 2 & 3
- Minor project works only