

De-Carbonizing the Campus: Planning, Tools & Technologies

CampusEnergy2023

February 27 – March 2, 2023

Gaylord Texan Resort & Convention Center | Grapevine, Texas



INTERNATIONAL
DISTRICT ENERGY
ASSOCIATION

University of Iowa Replacement of Steam Turbine Generators

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PRVN Consultants, Inc.



Agenda

- Project background
- Capacity expansion program objectives
- Plant electrical generation capacity
- TG8 clutched condensing tail
- Installed turbine performance
- Plant and distribution improvements
- Unique design conditions
- Questions

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Project Background



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Project Background



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Capacity Expansion Program Objectives



- New reliable boiler and turbine capacity
- Two new steam turbine generators to replace TG1 (installed in 1947) and TG5 (installed in 1952)
- More efficient in-plant and distribution processes

Previous Turbine Capacity



Pre-Project Plant Capacity

Total Plant Output Capacity	Electric (MW)
TG 6	18
TG 1	3
TG5	3
Total	24

Post-Project Turbine Capacity



Post-Project Plant Capacity

Total Plant Output Capacity	Electric (kW)
TG 6	18
TG 7 & 8	15
Post Project Plant Capacity	33

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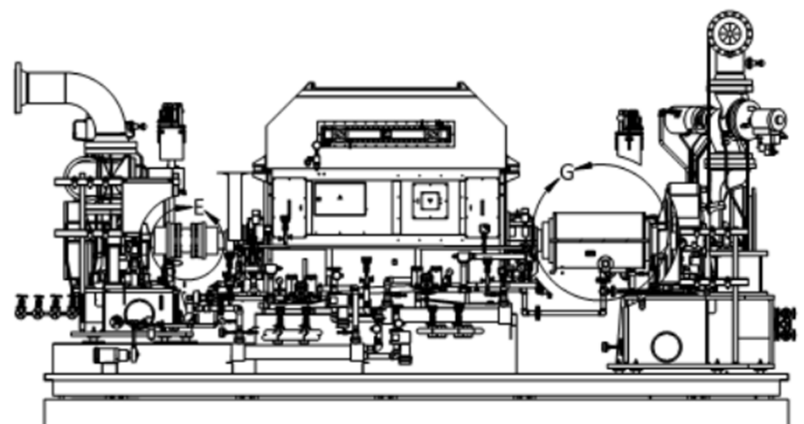
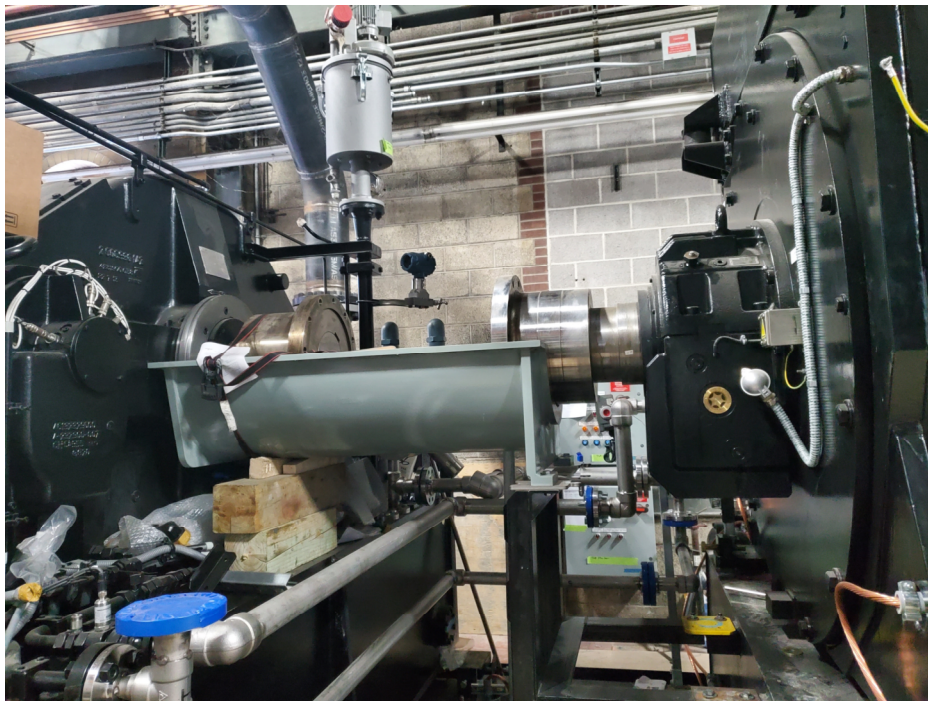
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Post-Project Turbine



Clutched Condensing Tail



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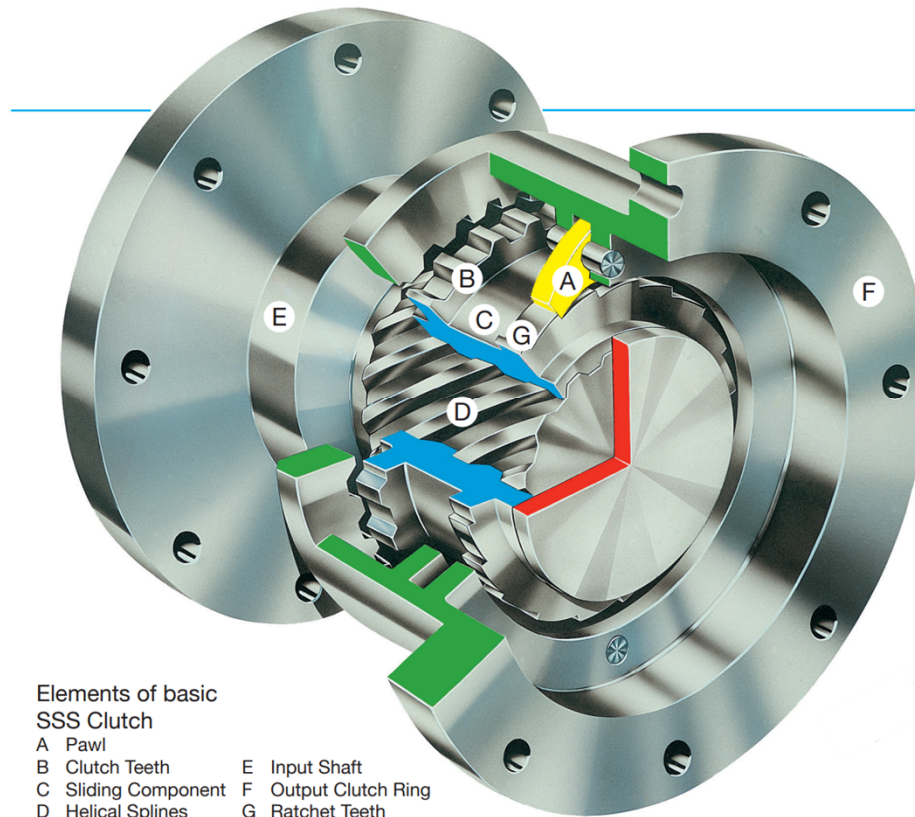
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Clutched Condensing Tail



Elements of basic
SSS Clutch

- | | |
|---------------------|----------------------|
| A Pawl | E Input Shaft |
| B Clutch Teeth | F Output Clutch Ring |
| C Sliding Component | G Ratchet Teeth |
| D Helical Solenoid | |

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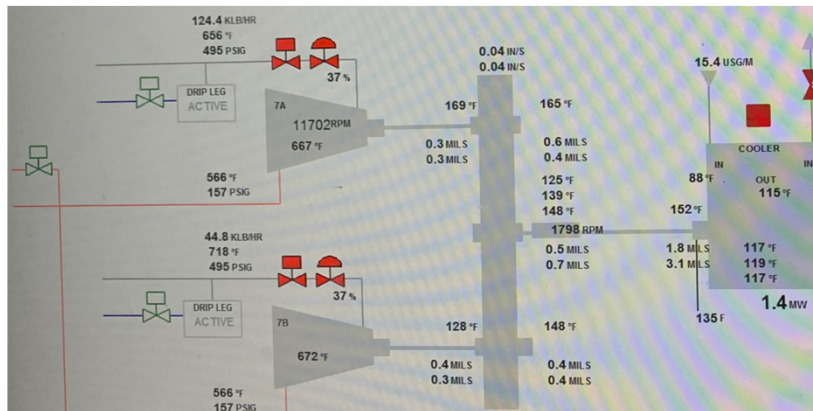
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Backpressure Turbine Performance

TG7

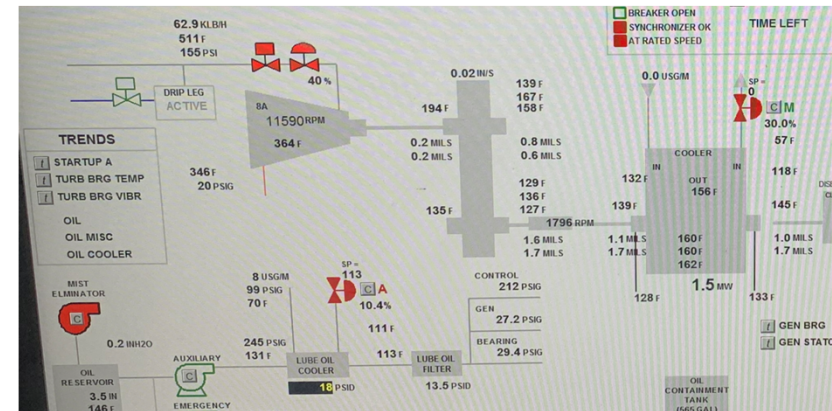


Univ of Iowa TG-7

Condition 1 - 750F Inlet Steam

	100%	75%	50%	25%	
Inlet Pressure	500	500	500	500	PSIG
Inlet Temperature	750	750	750	750	°F
Exhaust Pressure	155	155	155	155	PSIG
Exhaust Temperature	540	554	572	622	°F
Enthalpy	1,294	1301	1311	1337	Btu/lb
Turbine Speed	11,726	11,726	11,726	11,726	RPM
Mass Flow	200,000	150,000	100,000	50,000	lb/hr
Power Output	4,968	3,398	1,959	566	kWe

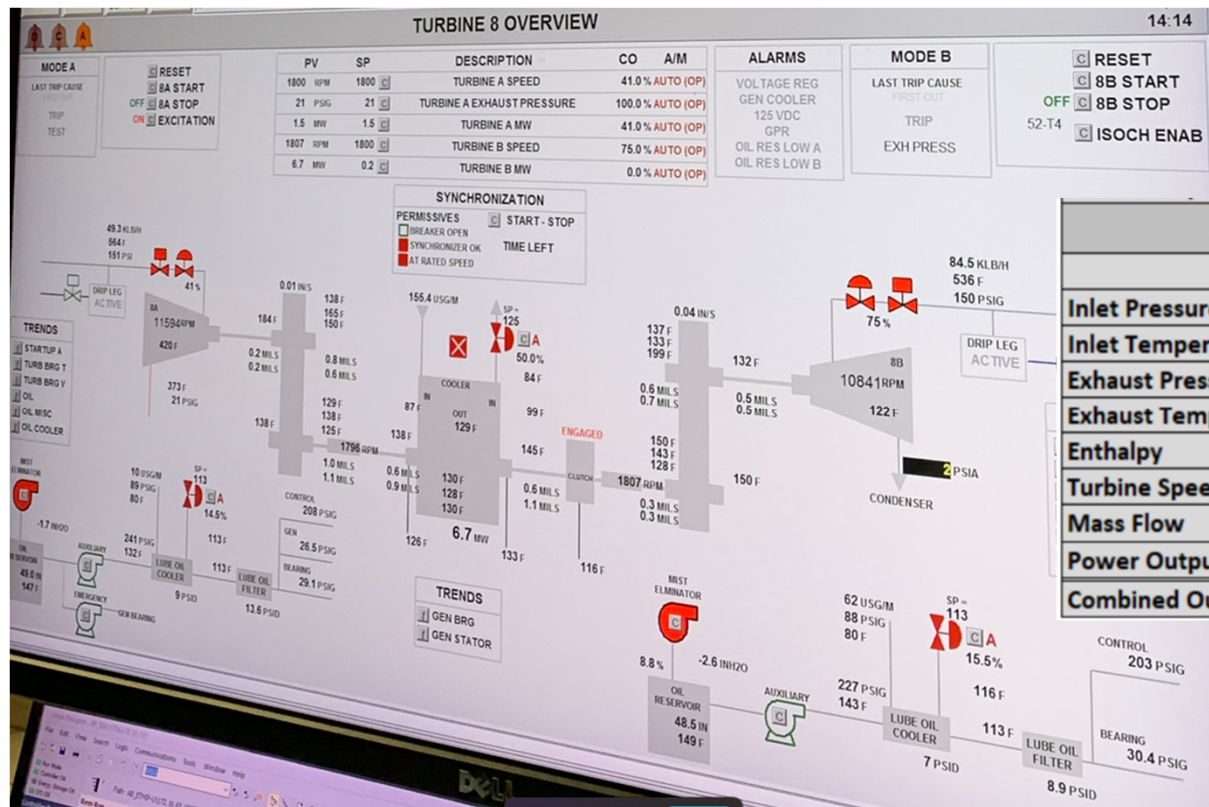
TG8A



Univ of Iowa TG8A (Backpressure)

	100%	75%	50%	25%	
Inlet Pressure	155	155	155	155	PSIG
Inlet Temperature	504	504	504	504	°F
Exhaust Pressure	20	20	20	20	PSIG
Exhaust Temperature	266	297	307	347	°F
Enthalpy	1,171	1,185	1,191	1,211	Btu/lb
Turbine Speed	11,590	11,590	11,590	11,590	RPM
Mass Flow	130,000	104,000	65,000	32,500	lb/hr
Power Output	3,671	2,508	1,428	504	kWe

Condensing Turbine Performance



Univ of Iowa TG8B (Condensing)					
	100%	75%	50%	25%	
Inlet Pressure	155	155	155	155	PSIG
Inlet Temperature	504	504	504	504	°F
Exhaust Pressure	-13	-13	-13	-13	PSIG
Exhaust Temperature	129	129	140	207	°F
Enthalpy	1,069	1083	1121	1152	Btu/lb
Turbine Speed	7,506	7,506	7,506	7,506	RPM
Mass Flow	90,000	67,500	45,000	22,500	lb/hr
Power Output	5,078	3,542	1,839	687	kWe
Combined Output	8,749	6,051	3,267	1,191	kWe

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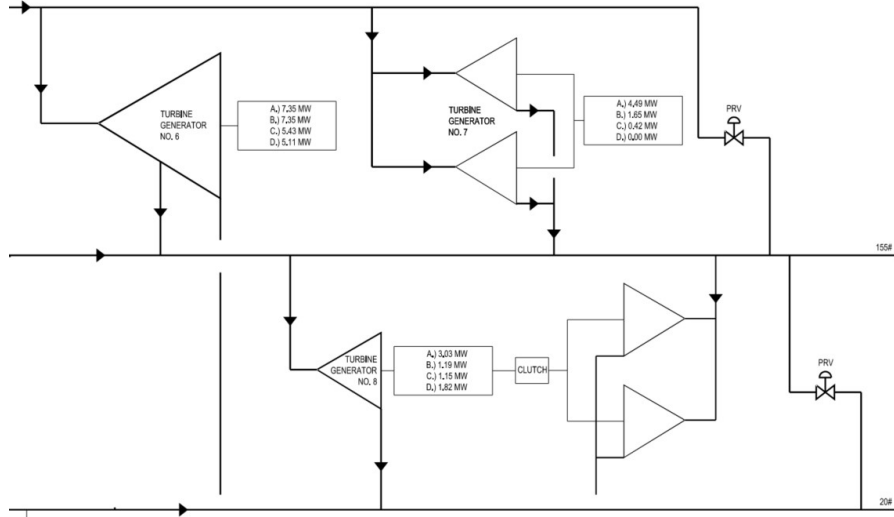
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Distribution Improvements



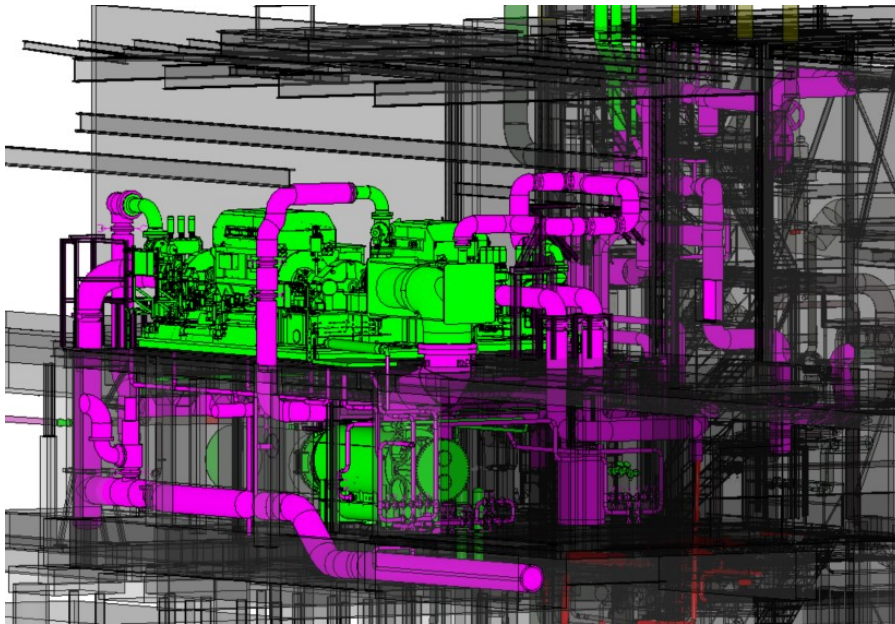
- Main Plant now meets larger campus steam loads more efficiently
- Condensing tail allows extra capacity for Storm and Isoch modes as well as peak shaving capabilities during high electric rate hours

Unique Design Conditions



- Vertical turbine condensate pumps
- Used to create ample suction head
- Coordinated installation of wells with Condenser Room floor replacement

Unique Design Conditions



- New steam pipe routing
- Designed to meet Howden and NEMA nozzle loads
- Routed within existing, congested plant
- No expansion joints used (with exception of condensing tail)

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Questions



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Thank You!

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