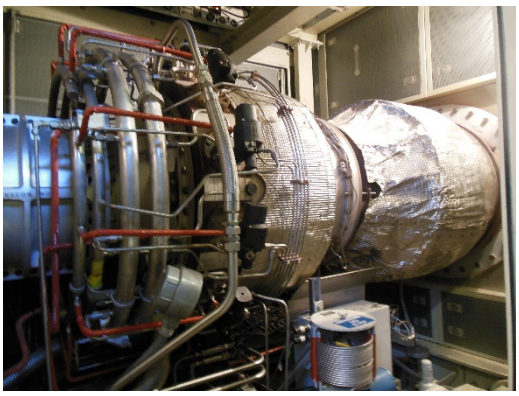
PROJECT SUMMARY

11 MW FOOD MANUFACTURING FACILITY CHP PLANT
DETAILED DESIGN & BID SPECIFICATION PREPARATION

PROJECT SUMMARY



Bridgestone Associates prepared a complete detailed design for an 11 MW Combined Heat and Power (CHP) plant for large food manufacturing plant in Iowa. This natural gas fired CHP plant is based around two used and refurbished Solar T60 combustion turbines with Rentech Heat Recovery Steam Generators (HRSGs). The CHP equipment was originally installed at the United States Naval Station Great Lakes (NSGL) in North Chicago, Illinois where it operated from 2005 until being shut down by the US Navy in 2014. The complete CHP plant was salvaged and removed by Bryan Power Generation and transported to the new location where it is being reinstalled adjacent to the large food manufacturing facility. It will generate approximately 11 MW of electrical power and up to 90,000 lb/hr of 350 psig steam for process use. Provision for a 2 MW 350/165 psig back-pressure steam turbine to be added later was designed into the system. Plant construction started in mid-summer 2016 with completion due in mid-2017.

PROJECT STATISTICS

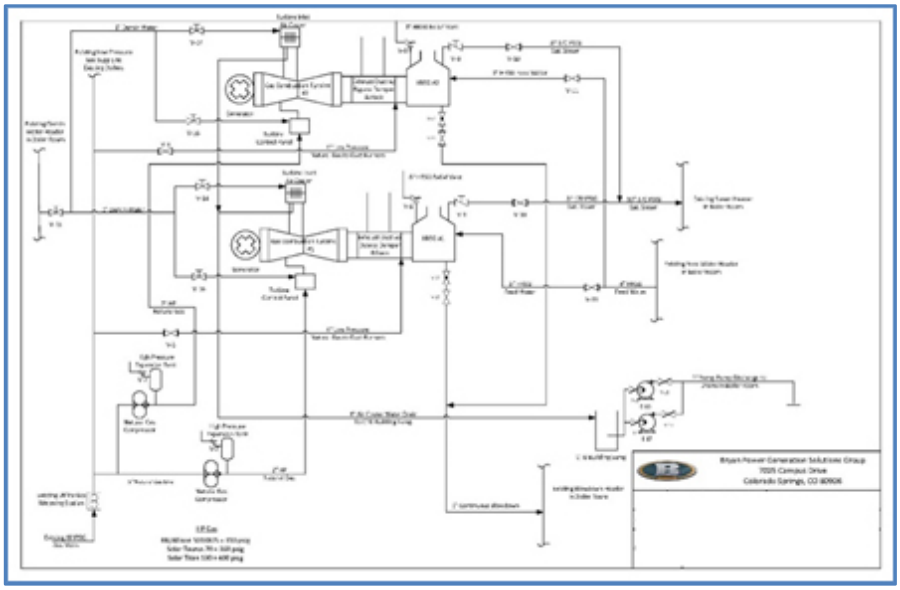
Client:	Confidential / Bryan Power Generation Solutions
Project Type:	Natural gas fired combined heat and power (CHP) plant
Size:	10.8 MWe and 90,000 lb/hr 350 psig steam
Unit Sizes:	2 x 5.4 MWe + 2 x 50,000 lb/hr Heat Recovery Steam Generators
Estimated Project Cost:	US$19.0 million
Plant Location:	Iowa, USA
Plant Elevation:	810 feet above sea level
Interconnection Voltage:	12.47 kV
Primary Fuel:	Natural gas
Back-up Fuel:	Propane
Fuel Input:	134 MMBtu/hr HHV without duct burners; 195 MMBtu/hr HHV with duct burners
Plant Steam Conditions:	350 psig, 500 ^{o}F
Combustion Turbines:	2 x Solar T60 Model 7801 Previously Installed at Naval Station Great Lakes, North Chicago, Illinois, USA
Burner Type:	Solar SoLoNOx
Emissions Controls:	Aqueous Ammonia Injected Selective Catalytic Reduction (SCR) System

HRSG:	Rentech 50,000 lb/hr Heat Recovery Steam Generators (HRSG) with Superheat
Duct Burners:	Coen
Steam Turbine:	2 MW 350 psig to 165 psig back pressure – to be added later
Natural Gas Compressors:	2 x Ariel 70 – 300 psig 1,200 scfm
Thermal (Steam) Use:	350 psig Steam for Future Back-Pressure Steam Turbine 165 psig Steam for Food Manufacturing

PROJECT DESCRIPTION

Through its on-going consulting arrangement with Bryan Power Generation Solutions of Colorado Springs, CO, Bridgestone Associates was initially contracted to prepare preliminary CHP feasibility analyses, equipment selections, and capital cost assessments for three large food manufacturing facilities. The facilities located in Georgia, Missouri and Iowa all use electric power and steam in the manufacture of breakfast cereals and other food products. As part of these preliminary feasibility studies, Bridgestone also evaluated the relocation and suitability of an existing 3.5 MW Allison 501KB5 CHP plant owned by the food manufacturing client at a to-be-closed in California.

After review of the results and recommendations of the preliminary feasibility studies, the client decided to proceed with a CHP project to be developed, designed and constructed at their Iowa facility. This CHP plant would be based around refurbished pre-owned combustion turbines and other pre-owned equipment as it was available, which would be supplied by Bryan Power.



Bridgestone assisted Bryan Power in locating and evaluating a complete but shut down 10.8 MW CHP plant that had operated at the US Navy's Great Lakes Station on the edge of Lake Michigan in North Chicago, Illinois. The plant had been constructed by Ameresco in 2004 to provide steam and electricity to the Navy's Basic Training Facility. It had operated from 2005 until 2014 when it was shut down as the Navy had determined that use of local heating systems throughout the Base's buildings versus a central steam plant with an extensive steam distribution system would reduce operations and maintenance costs. The CHP plant, the central boiler plant, and all associated equipment, were to be removed and salvaged or scrapped and the building re-purposed.

Once the CHP plant equipment had been identified, its technical suitability confirmed, and preliminary purchasing agreements executed between the Confidential Client and Bryan Power, Bridgestone was asked to prepare a complete evaluation of the potential capital costs to allow the client further internal evaluation and final approval of the necessary capital allocation. The evaluation prepared by Bridgestone included the development of a complete 35% Design and a +/- 10% capital cost estimate for the proposed plant. Prior to preparing this 35% Design, Bridgestone and Bryan Power conducted and prepared a detailed survey and inventory of all the equipment available within the existing plant. This included review of existing and available technical information and drawings.

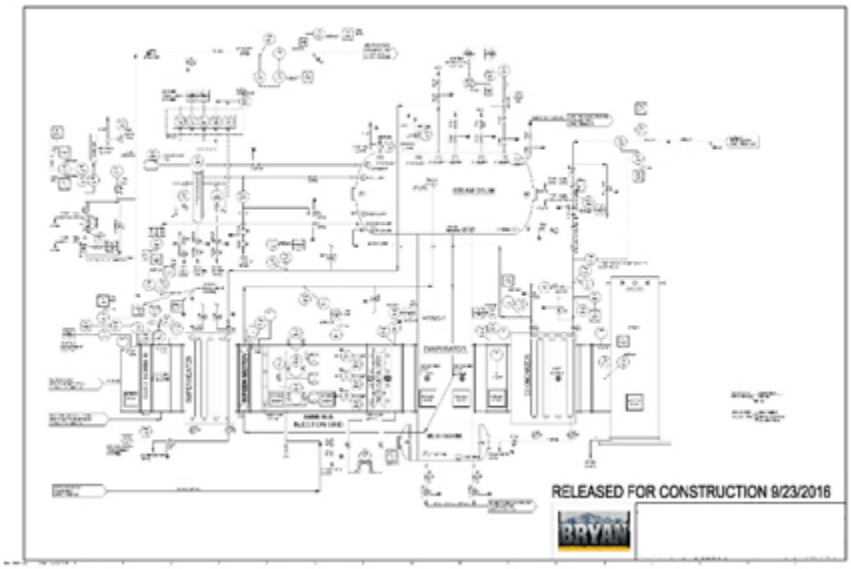
The 35% Design prepared by Bridgestone included preliminary layout drawings, one-line electrical drawings, P&IDs, process flow diagrams, and equipment, motor and instrument lists. The capital cost estimate included all major equipment and construction items and an assessment of the +/- percentage accuracy of each cost in order to be within the +/- 10% accuracy desired. Throughout this 35% Design process, Bridgestone interacted with the Confidential Client's plant personnel to tailor the design to meet their manufacturing plant's requirements and to maximize the re-use of the existing equipment at NSGL.

After evaluation of the capital costs and the benefits of the CHP plant, the Confidential Client agreed to proceed with the project in July 2016. At that time Bridgestone Associates was contracted by Bryan Power to prepare the complete Detailed Design of the plant. One of the primary goals of this complete design was to re-utilize as much of the existing NSGL CHP plant as possible in order to reduce capital costs. This meant that in addition to the major equipment components of the CHP plant, all of the exhaust stacks, ductwork, roof vent fans, instruments, valves, controls, piping, structural and support steelwork, conduit, and floor grating were to be re-used if possible. In addition, any other equipment required for the new CHP installation including valves and instruments that could be obtained from the NSGL boiler plant would also be purchased and re-used and re-purposed if possible.

In the process of the design of the new CHP plant, the Confidential Client wanted the design to allow space and connections for a third combustion turbine and HRSG, and a back-pressure steam turbine to be added at a later time. This meant that the CHP building and foundations, as well as some process systems had to be sized to allow for a third unit and the steam turbine.

One of the significant issues facing Bridgestone's structural design team was the very poor sub-surface conditions in the area of the new plant building. Compounding this was the existing design of the plant where the HRSGs and the exhaust stacks where stacked above the combustion turbine generator. This had been the design at NSGL as the CHP plant had been built into an old boiler building and, with the Client's desire to re-use and re-install the CHP plant equipment in the same configuration, this posed significant structural design issues. The overall weight of the equipment stacked vertically along with the high wind loading requirements on the 175ft stack, coupled with the goal of re-using and integrating the structural and equipment support steel into the building design, required a 90ft x 70ft x 3ft concrete pad approximately 6ft feet in the ground. Onto this pad the foundations for all the equipment could be connected and built.

Bridgestone's detailed design work included all structural, mechanical, piping and instrumentation systems and their interconnection with the food manufacturing plant including the development of the entire system P&IDs. In addition to the detailed internal design of the CHP plant and building, and the design of a gas compressor building, Bridgestone's design team designed a connecting pipe and pedestrian bridge to connect the CHP plant building to the existing boiler plant building. Bridgestone also worked with the Client to design a high pressure steam line to extend approximately 250ft into the food manufacturing plant to augment the existing steam header supply from the boiler house. With few existing structural drawings to work with, this design included complete stress analysis of the piping and support structure, as well preparation of the piping layout drawings and specifications.



Bridgestone's project team also prepared all of the civil, structural, mechanical and piping bid specifications for the Confidential Client to allow contractors to bid for the plant construction and equipment installation. In addition, Bridgestone closely assisted the onsite electrical contractor in the development of the electrical systems layouts and the integration of the instrumentation systems into the plant design. Bridgestone supported the Client in pre-bid meetings with contractors and in answering their questions.

Throughout the project Bridgestone provided technical support to Bryan Power's equipment salvage specialists and project team working at NSGL removing the equipment. This included identifying additional equipment that could be sold by Bryan Power and used by the Client.

The detailed design of the new CHP plant was completed in November, 2016. Plant civil work commenced in July 2016. Plant completion is scheduled for late spring 2017.