Boeing Building 88-30 – Final Assembly Building, 787 Manufacturing Plant North Charleston.

South Carolina

#### Mechanical engineering and BIM services for a 1.2 million s.f. manufacturing plant that will support the production for the new Boeing Dreamliner 787 aircraft. Project includes offices and support spaces interior to the building and on five levels with mezzanine for a total of 1.6 million s.f. Mechanical services provided as a subconsultant to the mechanical contractor, Gamewell Mechanical, Inc., in a design/ build contract arrangement with design-assist to Engineer-

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of-Record. **BIM services provided for mechanical and plumbing contractors (Gamewell Mechanical, Inc. and C.R. Hipp Construction) and electrical contractor (EIDeCo).** 2011 Revit MEP Suite and 2010 Navisworks Manage software was used in providing the 3D files for mechanical, piping and plumbing and for the clash detection effort.

Boeing Building 4-86 – 737 Paint Booth No. 4 Renton, Washington Mechanical engineering services for a large paint booth located at the end of an existing facility providing multiple positions and booths for painting of the assembled wings of the 737 product line, including the 737MAX. Large volume of conditioned air was provided for the various operating modes of the booth; Prep Mode, Paint Sprav Mode, Cure Mode and Cooldown Mode. Complex controls were designed and installed for the operation of the heating and ventilating systems and exhaust air systems equipped with paint filtration and extensive air monitoring for EPA reporting. Separate air handling system was provided for the Cure Mode with sidewall air distribution that covers the entire wing surface on both sides. Medium pressure steam coils provided for tempering the booth air and for the Cure Mode that delivers a maximum of 165 degrees F of clean air. Mechanical design engineering provided for the Process HVAC systems and controls provided as a specialty subconsultant.



Boeing Building 4-20 – 737 Seal Booths for Line 6 Renton, Washington

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Mechanical engineering services for four large Seal Booths constructed in the center of an active manufacturing assembly plant. Seal booths were designed for replacement of older booths and were equipped to handle both the upper and lower panels of the wings for the 737 product line. Large volume of conditioned air was provided for the various operating modes of the booths; Prep/Seal Mode, Paint Spray Mode, Cure Mode and Cooldown Mode. Complex controls were designed and installed for the operation of the heating and ventilating systems and exhaust air systems equipped with paint filtration and extensive air monitoring for EPA reporting. Medium pressure steam coils provided for the tempering of each booth and for the Cure Mode that delivers a maximum of 165 degrees F of clean air. Mechanical design engineering provided for the Process HVAC systems and controls provided as a specialty subconsultant.

U.S. Air National Guard F-15 Corrosion Control Aircraft Hangar Jacksonville, Florida Mechanical engineering services for a 10,600 s.f. singlebay corrosion control facility for the F-15 aircraft at the Jacksonville International Airport. Project included one wash bay, paint room with a prefabricated paint booth, offices, and support spaces. Mechanical systems include full outside air ventilating units for the high bay, heat is provided by a high temperature water boiler, wash water is heated by the same boiler through a heat exchanger, compressed air and breathing air provided by an oil-free reciprocating air compressor, office areas are provided air conditioning from a dedicated packaged heat pump. Plumbing systems include trench drains in the high bay that drain to an existing oil/water separator and

emergency shower/ eyewash stations located throughout the facility. Fire protection is provided with fire sprinkler system and a high expansion foam system for the high bay.





U.S. Army Corps of Engineers – C-130 Corrosion Control Aircraft Hangar

Pope Air Force Base, Fayetteville, North Carolina

## Aerospace & Aeronautical

Mechanical troubleshooting services for a 69,500 s.f. twobay corrosion control facility for the C-130 aircraft. Project included one wash bay and one paint bay with offices and support spaces located between the bays. Mechanical systems include full outside air supply units for the paint bay that filter and heat the air with direct-fired gas heaters. Exhaust air fans draw the air through the paint bay in a horizontal "push – pull" arrangement and then through three-stage paint filters located in the walls of the large hangar doors. Troubleshooting was required due to Air Force acceptance testing of the paint bay heating and ventilating system. Pre-testing indicated potential problems, but after tweaking the system, ventilating system passed on the first test witnessed by the Industrial Hygienist for the Air Force Base.





U.S. Air Force – Eastern Processing Facility Cape Canaveral Air Force Station, Florida

# Aerospace & Aeronautical

Large satellite processing facility for the U.S. Air Force. Facility includes three 140 foot tall ISO Class 5 clean rooms and one 180 foot tall ISO Class 3 clean room. Project included the design of high pressure gaseous nitrogen (GN2) and gaseous helium (GHE) process piping systems, propellant fuel and oxidizer piping systems, fuel incinerator, oxidizer scrubber, mechanical HVAC systems, stainless steel ductwork, desiccant dehumidifier systems, 3,300-ton central chiller and 30 mmBtu heating water plants, breathing air systems of high and medium pressures, safety ventilation systems, and



a PLC-based Facility Automated Management System (FAMS). Mechanical HVAC systems were computer simulated with computational fluid dynamics modeling to assure systems would perform with all the cleanliness levels and transient recovery requirements stipulated in the design criteria.

Boeing Building 88-19 (Formerly Vought Aircraft Industries, Inc.) – Manufacturing Plant North Charleston, South Carolina

## Aerospace & Aeronautical

Mechanical engineering services for a 340,000 s.f. manufacturing plant that will support the fuselage production for the new Boeing Dreamliner 787 aircraft. Mechanical systems include central chiller plant of water-cooled centrifugal chillers of 2,430 tons capacity, cooling towers, central compressed air plant with two 500 horsepower centrifugal air compressors, and central vacuum plant of two 50 horsepower rotary vane vacuum pumps. Air handling units



are provided as an N+1 arrangement. Clean Room area of 75,000 s.f. is physically separated from the Production areas within the building with the environmental requirements dictating two desiccant wheels for controlling very low humidity levels with six air handling units controlling the filtration and space temperature to maintain a ISO Class 5 cleanliness level for the composite production of the fuselage section. Heat for the facility provided by indirect gas-fired heaters located inside specific air handling units. Industrial grade walk-

in freezer (-10°F) and cooler (40°F) provided for storage of raw carbon material used in the composite production. Facility includes 38 robotic production cells and the largest autoclave in the World.





Boeing Building 88-20 (Formerly Global Aeronautica, Inc. – Fuselage Assembly Plant North Charleston, South Carolina

## Aerospace & Aeronautical

Mechanical engineering services for a 252,000 s.f. manufacturing plant that will assemble the fuselage for the new Boeing Dreamliner 787 aircraft. Mechanical systems include central chiller plant of water-cooled centrifugal chillers of 1,000 tons capacity, cooling towers, and central compressed air plant with two 300 horsepower centrifugal air compressors. Air handling units are provided as an N+1 arrangement. Heat for the facility provided by indirect gasfired heaters located inside specific air handling units.





Boeing Commercial Airplane Group --Building 88-22, Paint Facility North Charleston, South Carolina

## Aerospace & Aeronautical

Mechanical engineering services for a 75,000 s.f. prep and paint facility for the assembled fuselage for the new Boeing Dreamliner 787 aircraft. Facility consists of two prep booths and two paint booths. Paint booths are downdraft air delivery types with underflow exhaust air draw through three-stage filtration and charcoal final filters. Mechanical systems include central chiller plant of water-cooled centrifugal chillers of 2,200 tons capacity, natural gas-fired water boilers, large

> customized air handling units and central compressed air. Air handling units, boilers and chillers are located indoors on the top of the paint and prep booths.





Boeing Commercial Airplane Group – Corrosion Inhibitor Ventilation and Electrical Improvements Everett, Washington

Mechanical engineering for ventilation improvements to allow for application of Corrosion Inhibitor Compounds (CIC) in multiple locations in the factory (747 and 767 Main Assembly Building). Eleven separate design packages covering nine bid packages involved a total of 26 separate assembly positions in Buildings 40-22, 40-23, 40-24, and 40-33. Creative use of movable supply and exhaust fan carts, duct storage systems and optimized duct connections to work platforms and tools were typical of solutions used to accommodate the unique shapes and spray areas of each airplane section. Project also involved strict accounting controls including weekly reporting of efforts, manpower and earned-value analysis for formal presentations.



Florida Institute of Technology – Aviation Hangar Melbourne International

Airport, Melbourne, Florida Aerospace & Aeronautical

Mechanical engineering and fire protection services for a 16,800 s.f. aviation hangar located at the Melbourne International Airport for the aviation school at Florida Tech. The hangar features maintenance training for private aircraft servicing. Mechanical systems include a chilled water system with modular indoor air handling unit for the support areas and offices, air-cooled chillers, primary pumping arrangement, and Direct Digital Controls that monitor the hangar's power quality and lighting control system. Mechanical ventilation of hangar bay provided for air circulation whenever hangar doors are closed. Large central air stratification fan was provided for general operating ventilation. Fire sprinkler coverage provided throughout hangar bay and support spaces.



Boeing Commercial Airplane Group – Building 45-07 Field Steam Plant Everett, Washington Mechanical engineering services for a 8,000 s.f. steam plant to support paint hangar operations for Boeing 747, 767 and 777 aircraft on south field site of Everett Plant. Two dieselfired boilers each producing 125,000 lb/hr, 200 psig steam are supplied diesel fuel from an adjacent 200,000-gallon diesel fuel storage tank with secondary containment dikes. Steam distribution and condensate return piping were routed



through a new utility tunnel from the steam plant to five buildings. All high-pressure piping was computer analyzed for stress and thermal expansion with resulting supports, anchors and seismic bracing detailed on drawings. Standby power generators were provided with full capacity to start and operate entire steam plant as back-up power source.



Guardian Manufacturing, Inc. U.S. Air Force, Office of Space Launch – Eastern Processing Facility Cape Canaveral Air Force Station, Florida

## Aerospace & Aeronautical

Mechanical engineering services as design and installation support for Facility Automation and Management System (FAMS) controls contractor on the large 196,000 sq. ft. satellite processing facility for the U.S. Air Force. Facility includes three 140-foot tall ISO Class 5 cleanrooms and one 180-foot tall ISO Class 3 cleanroom. Scope of services includes the sizing and selection of control valves, damper actuators, flow meters, environmental monitoring equipment, and various sensors. Scope also includes the assistance of start-up and commissioning process during the 3.5 year construction project for the Programmable Logic Control systems. Design included the determination of the sequences of operation for the complex facility and systems and the review of the PLC flow charts.

U.S. Air Force, Office of Space Launch – Astrotech Facility Expansion Vandenberg Air Force Base, California Mechanical engineering technical review for the addition of a single high bay to an existing satellite processing facility operated by Astrotech for the U.S. Air Force, Office of Space Launch. Project consists of a 100-foot tall 20,400 sq. ft. ISO Class 5 cleanroom. Io Engineers provided technical review of mechanical systems as expert consultant to USAF.

