General Atomics Total Solution (GATS) Full-Scale Design Briefing to the State of Colorado

February 2001

PARSONS

GENERAL ATOMICS

GATS PROCESS OVERVIEW

- GATS is a two-step alternative to incineration
- Agents and energetics are first destroyed by neutralization (water or caustic hydrolysis)
- Neutralized agents and energetics are then converted to water, CO_2, and mineral salts using Supercritical Water Oxidation (SCWO)
- Neutralization is being developed by the Army for Aberdeen, Newport, and ACWA sites
- SCWO is being developed by the Army for Newport and ACWA sites

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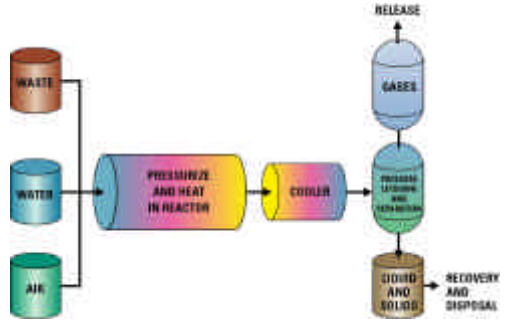
1-23-01

GENERAL ATOMICS

SCWO IS A SAFE, SIMPLE PROCESS



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GENERAL ATOMICS

ADVANTAGES OF SCWO

- Excellent kinetics/Destruction & Removal Efficiencies (DREs)
- No airborne particulates
- Low NO_X, SO_X and TOC
- Excellent process stability/control
- Simple safety measures/process upset recovery
- Capability for complete containment of effluents
- Compact equipment

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12-10-96

GENERAL ATOMICS

GATS FULL-SCALE DESIGN FOR PUEBLO

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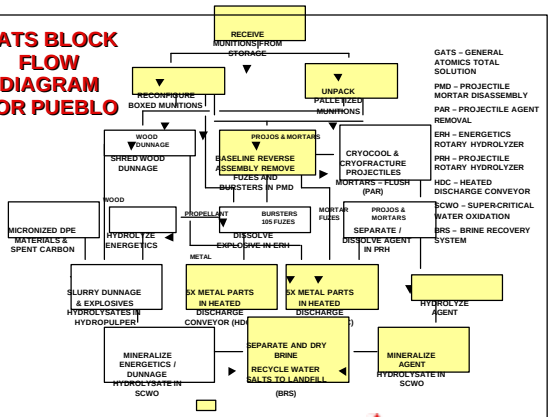
8-2-00

GENERAL ATOMICS

GATS BLOCK FLOW DIAGRAM FOR PUEBLO



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GENERAL ATOMICS

GATS SITE PLOT PLAN

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GENERAL ATOMICS

GATS MUNITIONS DEMILITARIZATION BUILDING

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GENERAL ATOMICS

GATS SCWO BUILDING

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GENERAL ATOMICS

DESIGN REVIEW - CORE PROCESSES

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1-23-01

GENERAL ATOMICS

BASELINE FRONT-END PROCESSES

- Munitions Receiving
- Unpack
- Reconfiguration
- Energetics Removal (Projectile Mortar Disassembly (PMD) machine)

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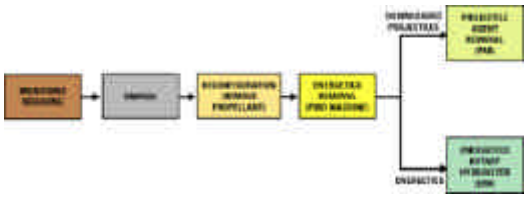
GENERAL ATOMICS

UNPACK BLOCK FLOW DIAGRAM



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GENERAL ATOMICS

PROJECTILE AGENT REMOVAL (PAR)

PAR Major Equipment

- Munitions Handling Robot (MHR)
  - Unit 1 – Transfers munitions from the PMD conveyor to the Cryobath Conveyor
  - Unit 2 – Transfers munitions from the cryobath conveyor to the Cryofracture Press
- Cryobath Conveyor
  - Embrittle munitions by cooling to equilibrium with liquid nitrogen temperature (-320°F)
- Cryofracture Press
  - Fractures munitions to access agent cavity
  - Discharges fragments to the PRH
- Projectile Rotary Hydrolyzer (PRH)
  - Hydrolyze chemical agent
  - Discharges liquid (with agent) to the Projectile Agent Hydrolysis (PAH)
  - Discharges metal fragments to the HDC
- Heated Discharge Conveyor (HDC)
  - Subjects metal fragments to 5X conditions; i.e., 15 minutes residence at 1,000°F
  - Maintains an inert environment
  - Discharges metal fragments to a dumpster
- Vent Gas Scrubber System

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GENERAL ATOMICS

CRYOFRACTURE SYSTEM BLOCK DIAGRAM

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GENERAL ATOMICS

COMPACT CRYOCOOLING CONVEYOR

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GENERAL ATOMICS

CRYOFRACTURE INTEGRATED PROTOTYPE LINE

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SUCCESSFULLY HANDLED OVER 200,000 MUNITIONS

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6-12-98

GENERAL ATOMICS

COMPACT CRYOFRACTURE PRESS

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GENERAL ATOMICS

CRYOFRACTURE ENSURES ACCESSING OF AGENT

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4.2 IN. MORTARS

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155 mm PROJECTILES

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BOXED 4.2 IN., MORTARS

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105 mm PROJECTILES

DRUMMED MINES

ROCKETS

CRYOFRACTURE ALSO DESTROYS MUNITION BODIES

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GENERAL ATOMICS

PROJECTILE ROTARY HYDROLYZER (PRH)

DESIGN PARAMETERS FOR PRH	
Residence Time	1 hour
Drum Diameter	6 feet
Drum Length	40 feet
Flight	Spiral, 2.5 ft/pitch/40 ft long
Lifting flights	Similar to ERH
Rotational speed (nominal)	16 rotations per hour
Operating temperature	194°F
Operating pressure	Ambient
Process water per lb. of agent	5.7 pounds

Energetics Rotary Hydrolyzer (ERH) TEST DRUM

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HEATED DISCHARGE CONVEYOR (HDC)

- Similar to baseline HDC
- Enclosure 6' W by 5' H by 55' L
- Conveyor pan: 36" W by 10" D by 12" L (approximate)
- Conveyor material: stainless steel 316L
- Rounds per pan: approximately 2
- Conveyor speed 1.4 ft/min
- Total residence time: 40 min
- Heater load: 1M BTU/hr
- Nitrogen purge flow: 234 lb/hr
- Vent Gas Scrubber

PROJECTILE AGENT HYDROLYSIS (PAH)

- Design based on Aberdeen system for bulk mustard
- PAH capacity is 7,750 lb/hr of 15% solution from PAR.
- Six batches can be handled in 4 N_2-blanketed titanium reactors during a 12-hour shift, 6 days/week.
- Each reactor can heat a 15,500 lb batch of solution to 194°F, mix and circulate for complete hydrolysis in 1.5 to 2 hrs.
- After verifying complete destruction, HCl formed is neutralized with 50% NaOH and the pH is raised above 11.
- The hydrolysate product is pumped to an 18,000 gal. storage tank for feed to SCWO.

AGENT HYDROLYSATE REACTOR AT CAMDS

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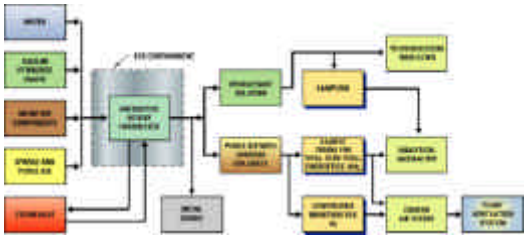
ENERGETICS ROTARY HYDROLYZER (ERH) BLOCK FLOW DIAGRAM



ERH MAJOR EQUIPMENT

- Skip Hoist
  - Transfer energetic materials from the PMD transfer cart to the ERH
- Energetics Rotary Hydrolyzer (ERH)
  - Hydrolyze energetics in a caustic solution
  - Discharge solution to CSTRs for verification of destruction
  - Discharge metal parts to the HDC
- Heated Discharge Conveyor (HDC)
  - Similar to PRH-HDC
- Vent Gas Scrubber
  - Recirculate condensables to the ERH
  - Scrub and filter vent gases
  - Discharge vent gases to the facility HVAC exhaust system

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GENERAL ATOMICS

FULL-SCALE ROTARY HYDROLYZER

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GENERAL ATOMICS

DUNNAGE SHREDDING AND HANDLING (DSH) SYSTEM

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GENERAL ATOMICS

3 INDEPENDENT TRAINS TO PROCESS DUNNAGE

- The wood shredding processing - to size-reduce 500 -1000 lb/hr whole wood pallets and assorted wood products to < 1-mm
- Plastics and rubber materials cryo-milling - to size-reduce 15 - 90 lb/hr DPE material to < 1-mm
- Spent carbon processing - to wet grind 30 lb/hr spent activated carbon from the HVAC system to < 0.5-mm

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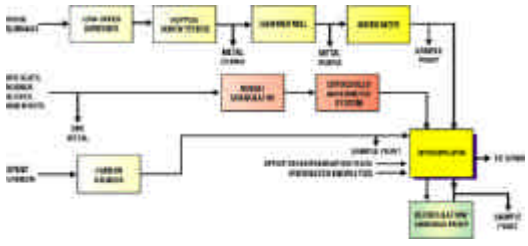
GENERAL ATOMICS

DSH BLOCK FLOW DIAGRAM



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GENERAL ATOMICS

WOOD PROCESSING LINE

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LOW-SPEED SHREDDER AND HOPPER/SCREW FEEDER

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HIGH-SPEED SHREDDER

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MICRONIZER

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5-18-00

GENERAL ATOMICS

GRANULATOR SYSTEM

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DSH HYDROPULPER

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8-21-99

GENERAL ATOMICS

SUPERCRITICAL WATER OXIDATION (SCWO)

- SCWO operates at 1200°F, 3400 psig in a vertical, downflow mode
- Separate SCWO reactors are used to process Agent Hydrolysate and Energetics/Dunnage Hydrolysate
- Process input is hydrolysate, oxidant and fuel (70% isopropyl alcohol)
- Steam is used to preheat SCWO reactor during startup only
- Nitrogen purge cools and protects outside of corrosion-resistant removable liner
- SCWO effluent is cooled by direct water quench followed by a water-cooled heat exchanger
- Process effluent is CO_2, O_2, N_2, water and salts

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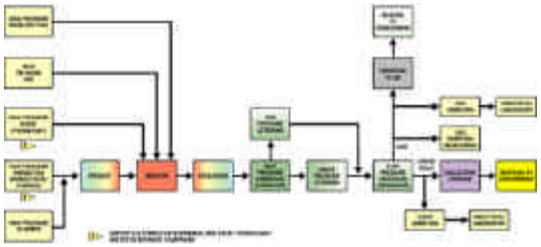
GENERAL ATOMICS

ACWA SCWO SYSTEM BLOCK FLOW DIAGRAM



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GENERAL ATOMICS

SUPERCRITICAL WATER OXIDATION (SCWO)

FULL-SCALE SCWO SYSTEM EQUIPMENT SIZES PER SCWO TRAIN (1)

Equipment Component	Requirement (normal operating conditions)
Reactor	18.4 in.ID x 221 in. long (process dimensions) 1.25 in. thick vessel - 1 1/4 Cr -1/2 Mo steel
Reactor Liner	0.030 in. titanium
Process Oxidant	Air
Water Feed Pump (to preheater)	1 gpm, 3800 psi
Hydrolysate Feed Pump	2 gpm, 3800 psi
Quench Pump	25 gpm, 3800 psi
Auxiliary Feed Pump	1 gpm, 3800 psi
High Pressure Oxygen System	2560 lb/hr
High Pressure Nitrogen System	2500 lb/hr
Hydrolysate Tank	16 hr holdup, 25% free space, 12,000 gal
Water Tank	1 hr holdup, 25% free space, 2,400 gal
Auxiliary Fuel	750 gal. Tank
Transfer Pumps	4 pumps
Startup Preheater	600 kw steam generator - 1000° F, 3800 psi
Cooldown Heat Exchanger	10.5 million Btu/hr - U-tube heat exchanger
Gas Pressure Letdown	Redundant control valves and pressure regulators
Liquid Pressure Letdown	Redundant capillaries and control valves

(1) Two SCWO units required each for AHS and EHS, four trains total.

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GENERAL ATOMICS

EST SCWO SYSTEM

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GENERAL ATOMICS

DESIGN REVIEW - BALANCE OF PLANT

BALANCE OF PLANT

- Processes
  - Chilled water
  - Cooling water
  - Decon/spent decon solution
  - Potable water
  - Steam/condensate
  - Fuel gas - for building heat
  - Fire protection
  - Hydraulic oil supply
  - Instrument/plant compressed air
  - Liquid nitrogen/oxygen
  - Chemicals - caustic soda
  - HVAC
  - Brine Drying
- Facilities
  - PUB - Process and Utilities Building
  - PMB - Personnel and Maintenance Building
  - ECF - Entry Control Facility
  - LAB - Laboratory
  - PSB - Personnel Support Building
  - FIL - Filter Building
  - WHS - Warehouse
  - TCF - Treaty Compliance Facility
  - MSB - Munition Storage Building
  - Guardhouse

STRUCTURAL DESIGN

- ECR conceptually designed to resist loads due to maximum explosive value of 5 lbs of equivalent TNT including factor of safety of 1.2
- ERH conceptually designed to resist loads due to maximum explosive value of 14 lbs of equivalent TNT including factor of safety of 1.25
- MDB conceptually designed as overall Steel braced framed Structure except for ECR, ERH and Agent Neutralization rooms, which are independent, cast in place concrete structures.
- SCWO building is conceptually designed as steel braced framed structure.

UTILITIES

- Liquid Nitrogen System
  - Cryobath
  - Vaporizer and Receiver
- Liquid Oxygen System (or HP compressed air)
- Water Systems
  - Demineralized Water Package
  - Cooling water systems
    - Process Cooling Water
    - Chilled Water System

UTILITIES (Cont'd)

- Combined air compressor package for instrument, plant, and life support air
  - Air dryer Package
  - Instrument Air Receivers
  - LSS Air Receiver
  - LSS Air Cooler
  - HP Air Bottle Filling System
- Fuel Gas System
- LPG System
- Steam and Condensate Systems
- Building Heating and Cooling
  - HVAC Chiller
  - Hot Water Boiler

HVAC SYSTEM

- Cascading ventilation system from areas of lower to higher contamination levels
- Level A areas minimized for volume and air flow requirements (20 room air changes per hour)
- Level B areas designed for 10 room air changes per hour
- Level C areas designed for 6 room air changes per hour
- Ventilated air discharges from MDB to charcoal filter system

BRINE RECOVERY SYSTEM

- Brine Concentrator
- Evaporator
- Crystallizer
- Recovered Water

GENERAL ATOMICS

STATUS OF ENGINEERING DESIGN STUDIES (EDS) TESTING

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GENERAL ATOMICS

ENERGETICS ROTARY HYDROLYZER

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ERH and Scrubber System

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ERH Test Facility at DPG

- Processed fuzes
- Processed energetics in bursters

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GENERAL ATOMICS

MICRONIZED PRODUCTS

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Wood

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Carbon

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Plastics/Rubber

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Slurry

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GENERAL ATOMICS

ASSEMBLED CHEMICAL WEAPONS SCWO TESTING

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Slurry Feed Skid

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Reactor Skid

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SCWO Reactor

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Compressor/Cooling Tower Skid

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Auxiliary Fuel & Effluent Skid

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GENERAL ATOMICS

MUSTARD HYDROLYSATE AND SCWO EFFLUENT SAMPLES

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Mustard Hydrolysate Sample

SCWO Effluent Sample (shaken to show cloudy suspension of Titania corrosion products)

SCWO Effluent Sample (showing Titania precipitate settled on bottom and clear water phase above)

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1-23-01

GENERAL ATOMICS