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DECONTAMINATION AND DECOMMISSIONING OF BIG ROCK POINT NUCLEAR PLANT

Tim Carraway
GTS Duratek Inc.
628 Gallaher Road
Kingston, Tennessee 37763
(865) 220-0222

Bob Wills
Consumers Energy Company
Big Rock Point Decommissioning Project
Charlevoix, Michigan
(231) 547-8212

ABSTRACT

Consumers Energy Company began operation of the Big Rock Point Plant in September 1962. It was the first commercial nuclear power plant constructed in Michigan and the fifth in the United States. The General Electric Boiling Water Reactor was rated for 240 Megawatts Thermal and was built by the Bechtel Corporation. The plant is located 4 miles northeast of Charlevoix, Michigan. The service water source and ultimate heat sink is Lake Michigan.

In June 1997, Consumers Energy Company notified the Nuclear Regulatory Commission (pursuant to 10 CFR 50.82(a)(1)(I)), that Big Rock Point Plant would permanently cease operation in August 1997. The reactor was permanently shut down as stated, ending 35 years of electric power generation as the nation's oldest and longest running nuclear power plant. It was closed because its relatively small size (67 MW Electric) was likely to make it too expensive to operate in an increasingly competitive environment.

Consumers Energy awarded GTS Duratek a contract in September 1998 for waste processing services related to the decommissioning of the Big Rock Point Nuclear Power Station. GTS Duratek with oversight and management of Consumers Energy is providing on-site packaging, transportation, processing and disposal of the radioactive and/or hazardous waste associated with the decommissioning of the power plant. The two companies have developed an integrated on-site and off-site approach.

INTRODUCTION (1)

Consumers Energy Company began operation of the Big Rock Point Plant in September 1962. It was the first commercial nuclear power plant constructed in Michigan and the fifth in the United States. The General Electric Boiling Water Reactor was rated for 240 Megawatts Thermal and was built by the Bechtel Corporation. The plant is located 4 miles northeast of Charlevoix, Michigan. Consumers Energy Company notified the Nuclear Regulatory Commission (NRC)

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pursuant to 10 CFR 50.82(a)(1)(I), that the Big Rock Point Plant would permanently cease operations. On August 29, 1997, the reactor was permanently shut down, ending 35 years of electric power generation. It was closed because it's relatively small size was likely to make it too expensive to operate in an increasingly competitive environment.

Drivers for Decontamination and Decommissioning of Nuclear Power Plants include;

- Nuclear Plants are reaching the end of their effective life
- Deregulation is driving the economic decisions to shut down

Consumers Energy Company's goal is to immediately dismantle Big Rock Point Plant in a safe, environmentally conscious, and cost effective manner take the plant to GREEN FIELD. This action must result in a timely removal of the existing nuclear plant in accordance with the DECON option found acceptable to the NRC. It is expected to result in the complete dismantlement and restoration of the site. The facilities remaining will be to support dry storage of the fuel until the fuel has been transferred offsite to a Department of Energy (DOE) or other authorized facility.

The following activities have or are anticipated to occur during the dismantlement period:

- Perform primary system decontamination,
- Establish a site construction power system,
- Remove asbestos insulation in conjunction with plant piping systems,
- Remove turbine control oil,
- Establish a spent fuel pool cooling system independent of existing plant systems,
- Construct an Independent Spent Fuel Storage Installation (ISFSI) for dry cask storage,
- Establish a monitoring location which allowed deactivation/dismantlement of the control room,
- Dismantle systems, structures and components not required for safe storage of spent fuel,
- Conduct decontamination of facility surfaces, components and piping surfaces,
- Conduct soil remediation as necessary,
- Ship and properly disposition all radioactive material
- Assay all bulk material and determine if they are non-radioactive and dispose of such clean material in a Michigan class II land fill.
- Perform a comprehensive final status survey to demonstrate compliance with approved site release criteria.

Consumers Energy Company is in the third year of the seven year plan to restore the site to a green field. Progress to date includes;

- Removal of all non fuel waste from the SFP including the shipment and disposal of over 100,000 curies of radioactive material
- Creation, revision or deletion of more than 630 procedures for change to a D&D site
- Chemical decontamination of the primary system (dose rates reduced up to 90%)

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- Installation of a decommissioning power supply
- Significant hazard reduction that included asbestos, sodium pentaborate, acid and caustic solutions
- Significant plant equipment removal including the generator and exciter
- Removal of 3,000,000 pounds of low level radioactive material, shipment to GTS for processing and disposal and
- License activities for the removal of bulk material with PCB coatings, working with state and NRC staff for the local disposal of non radioactive concrete and building debris

INTEGRATED MANAGEMENT APPROACH

Together, Consumers Energy and its contractors “ BNFL and GTS Duratek” will perform decontamination of building structures, equipment removal, dismantling, and waste processing, shipping and disposal. Consumers Energy will provide contractor oversight and control in all areas of D&D with particluare oversight in the areas of waste processing, classification and disposal. Big Rock Point will provide the oversight in the form of RadWaste assessment teams. Big Rock Point personnel will perform 100% of the waste sorting at the site and will identify any components requiring special waste handling. The escalating disposal costs require this integrated waste processing approach.

Subcontracted to GTS Duratek are three other companies; LLC, Zhagrus Environmental, Inc., and Canberra Industries. Zhagrus, a subsidiary of Envirocare of Utah will support to facilitate waste shipments to the Envirocare disposal site. Zhagrus will provide such services as; profiling, receipt, acceptance, rail transportation, and in-ground disposal of radioactive and mixed wastes. Canberra provides analytical instrumentation for the measurement and quantification of radioactive materials. They will be used for profiling and assaying of waste on this project.

Schedule and Milestones

The activities planned for decommissioning of the Big Rock Point Plant reflect the DECON option for the site. This option is found acceptable to the NRC in its Final Generic Environmental Impact Statement. Table I shows the preliminary time line of the significant decommissioning activities. 10 CFR 50.2 defines major decommissioning activities as those that;

- result in permanent removal of major radioactive components (i.e., reactor vessel and internals, large bore reactor coolant system piping, etc.)
- permanently modifies the structure of the containment, or
- results in dismantling components for shipment containing Greater Than Class C waste.

Table I

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Contractor On-Site Responsibilities

BNFL and GTS Duratek assisted Consumers Energy in developing project specific plans and procedures such as Health & Safety Plan and a Quality Assurance Project Plan. BNFL and GTS Duratek performed a detailed review of the characterization data and are developing a waste disposition plans. These plans define the proposed monitoring, segregation, packaging, transportation and processing methods for the waste types and quantities. Guidance is provided to Consumers Energy and the Major Component Removal Contractor "BNFL" with regards to preparation of waste for surveys, packaging, marking, labeling and preparation for shipment.

BNFL and GTS Duratek provide guidance to Consumers Energy during the removal and packaging of waste on-site. This minimizes unloading and processing costs at either of the off-site processing facilities. The material will be sorted by the following;

- Material type (i.e., carbon steel, aluminum, etc.)
- Size, geometry, and weight, and
- Radiological conditions (i.e., dose rates, smearable contamination, etc.)
- Hazardous and Chemical conditions (i.e., PCBs, asbestos, etc.)

Schedule and arrangement for transportation vehicles and appropriate shipping containers will be arranged and coordinated for processing of the wastes at the different processing sites.

Consumers Energy Responsibilities

Consumers Energy provided site specific training to BNFL and GTS Duratek on-site personnel. They also provide all the necessary isotopic information to allow GTS Duratek to perform curie estimates and complete shipping manifests. This includes use of Consumers Energy's radwaste inventory and manifesting program. Finally, Consumers Energy sorts, size reduces and places waste materials into designated containers.

WASTE STREAMS AND QUANTITIES (2)

The following waste streams and their respective quantities are assumed to fall within the scope of GTS Duratek's services (Table II). The largest waste stream is by far the potentially clean concrete. The total of the waste streams equals about 48,000 tons of waste materials.

Metal waste types may include; stainless steel, brass, bronze, aluminum, inconel and copper. The waste forms of the metals will come from pipe and pipe components, tubing, structural shapes such as I-beams, angles and channels. Dry Active Waste is defined as material such as; paper, cloth, wood, plastic, rubber and cardboard. Asbestos waste includes materials such as insulation, panels, tiles and gaskets. Concrete materials will include; building foundations, site structures, shield walls, and residues from on-site decontamination activities. Contaminated lead will consist of sheets, plates, bricks and blankets. Decommissioning equipment may include fork

trucks, pallet jacks, rigging equipment, miscellaneous hand tools, generators and welding machines, transfer bins/boxes and equipment, and scaffolding.

Table II. Estimated Waste Quantities	
Waste Stream	Weight (lbs)
Potentially Clean Metals	4,779,450
Potentially Clean Concrete	84,600,000
Dry Active Waste	450,000
Asbestos	324,000
Radioactively Contaminated Metals	3,496,114
Activated Metals	2,086
Radioactively Contaminated Concrete	797,640
Activated Concrete	234,900
Radioactively Contaminated Lead	56,800
Contaminated Soil	524,700
Contaminated/Potentially Clean Decommissioning Equipment	300,000
Large Components	Included in Rad Metals
Total	95,565,690

PROPOSED WASTE TREATMENT AND PROCESSING (3)

Based on the information provided to date on the expected waste types, quantities and radiological conditions, GTS Duratek developed an approach to Big Rock's waste. This approach will assure the waste is properly and safely processed and disposed with the lowest cost available. This approach employs a hierarchy principle of evaluating and applying the methods which reduce the amount of radioactive waste to be handled and disposed. Figure 1 presents a flow diagram for potentially clean material. The following sections describe the processing approaches to specific waste streams and additional information on key process technologies.

Dry Active Waste Processing

The Dry Active Waste (DAW) consists of various incinerable, compactible, and noncompactible materials such as clothing, respirators, trash, paper, scaffolding, wood, rope, etc. Figure 2 outlines how DAW typically is processed. DAW suspected to be potentially radioactively clean is identified, segregated and loaded into Green is Clean (GIC) containers. This saves additional sorting time at the offsite GTS Duratek facility. DAW that is suspected to be contaminated will be shipped to the GTS Duratek Central Volume Reduction Facility (CVRF) and sorted. The contaminated material will be sorted between materials suited for incineration or compaction.

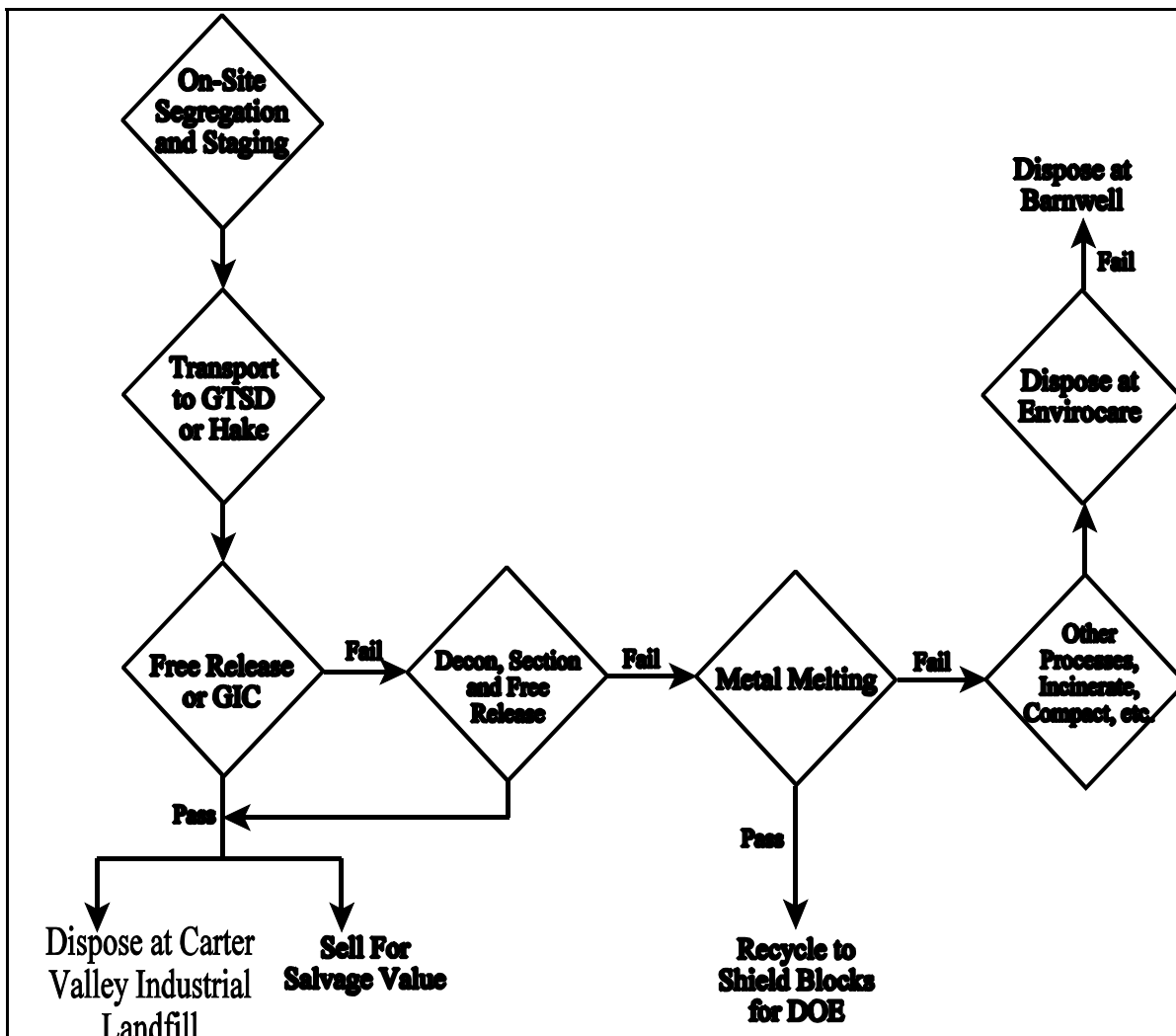


Fig 1. General Processing Approach

The incinerator is the process of choice for DAW because it can process a wide range of DAW types. Incineration of DAW requires minimal process adjustment and achieves an average volume reduction of 100:1. Compaction achieves an average volume reduction of 4:1.

Potentially clean DAW will be monitored by technicians using standard survey instruments or through automated monitoring and conveyance systems. The Green-Is-Clean (GIC) program consists of a 55-gallon drum and B-25 box sized assay system and support equipment (i.e., box dumper, conveyance system, shredder, etc.). Volumetric assay is performed on the waste, verifying the waste is free of radioactive contamination and can be released in an industrial landfill.

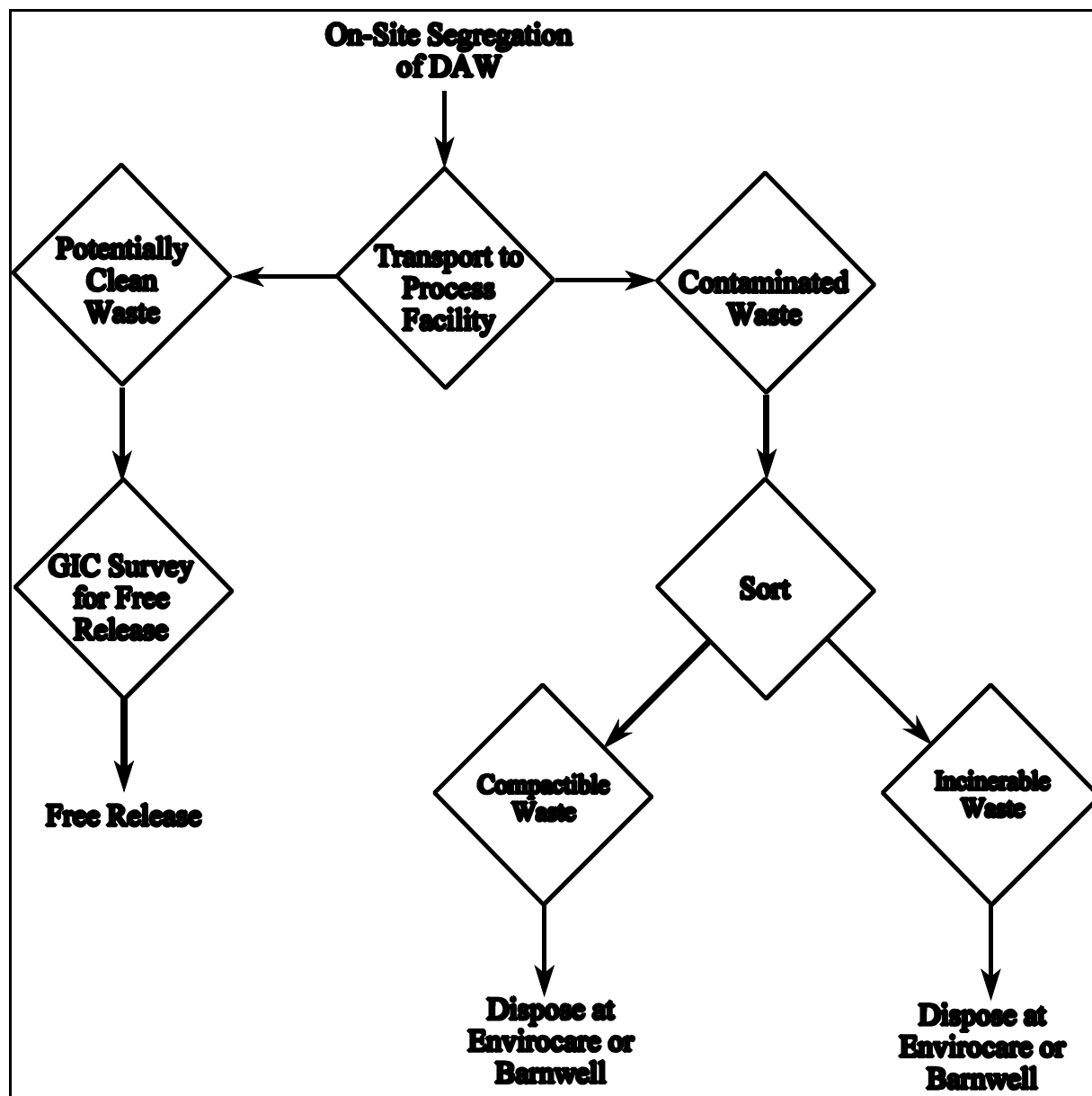


Fig 2. DAW Flow Diagram

Asbestos and Hazardous Waste Processing

Asbestos material will be removed by others from the plant during decommissioning activities. This material will have to be clearly segregated and marked to prevent mixing with other waste streams. Asbestos material will also be segregated into potentially clean (GIC) and contaminated waste. The potentially clean asbestos will be directed to the Green-Is-Clean program where assays may allow it to be released for disposal in an industrial landfill. The contaminated asbestos will be sent to the CVRF and designated for compaction. Due to the hazardous nature

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of asbestos, no sorting or incineration is considered an effective option. A volume reduction of 8:1 is achieved using compaction.

Hazardous wastes are likewise segregated as clean or radioactively contaminated. Non-radiological hazardous materials such as PCB contaminated oil, mercury vapor lamps, lead and lead contaminated paint are generated from decommissioning activities.

GTS Duratek provides for the packaging, shipment, processing and disposal for the hazardous waste materials. Zhagrus Environmental will be used for mixed waste packaging, shipment, treatment and disposal at Envirocare.

Resin Processing

The resin generated is handled through on-site dewatering and transferred to a cask for direct shipment to Barnwell. A High Integrity Container (HIC) is pre-installed in a licensed shipping cask for shielding purposes. Resin transfers are made into the HIC and then dewatered.

Metal Processing

The three different categories of metals are presented in Table III. The metal processing flow is outlined in Figure 3 below.

Table III. Metal Categories	
Metal Category	Radiological Condition
Contaminated Metal	Exterior or interior surfaces are contaminated such that the metal is considered to a Surface Contaminated Object.
Clean Metal	Metal that is characterized as clean, free of radiation, and able to be released for unrestricted use or disposal.
Activated Metal	Metal that has become radioactive from exposure to neutron irradiation and the total object is inherently radioactive.

As with the other waste streams, the metal components are categorized as clean (GIC) or radiologically contaminated. The metal is sized reduced as necessary for additional surveys and free released. For free release within the Green-Is-Clean program, some metals (i.e., small piping, sheet metal and low density metal) can be shredded to facilitate monitoring. Larger pieces of metal will require hand surveying. If the metal is determined to have no salvage or resale value, it will be sent to and industrial landfill.

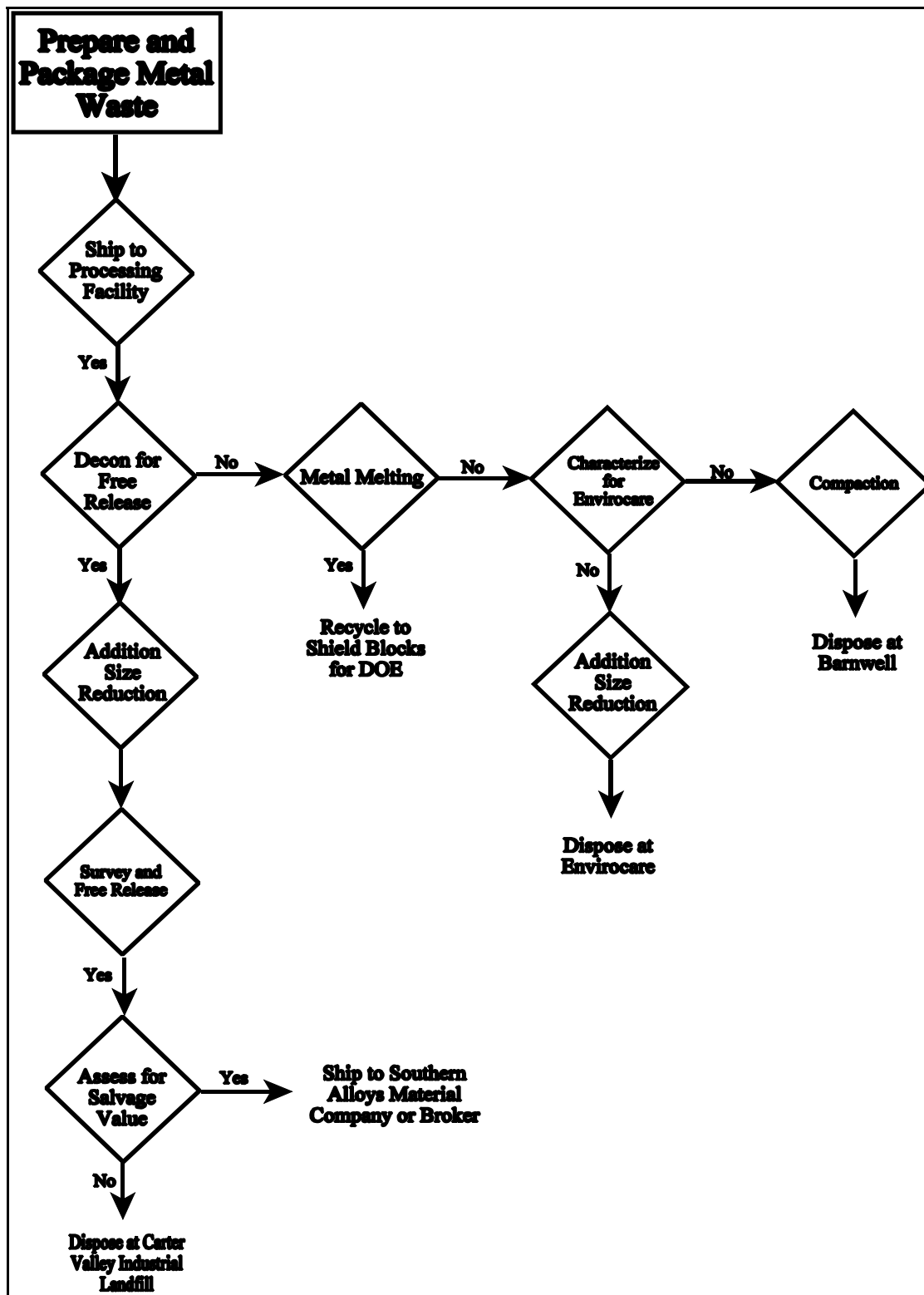


Fig 3. Metal Processing Flow Diagram

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Contaminated metals consist of systems exposed to the corrosion and activation products carried during the BWR steam cycle (e.g., condensate system, cooling water supply system, etc.). This waste stream includes the following materials;

Tanks	Piping	Pumps
Valves	Heat Exchangers	Conduit
Cable Trays	Pipe Hangers	Grating

The metal is sized to allow DOT legal weight transport in available packages such as 20-foot Sea/Land containers, B-25 boxes and 55-gallon drums. Contaminated metals are staged and prepared for shipment to the off-site processing facility. This metal waste is typically evaluated and processed in accordance with the following methods;

1. Decontamination for free release
2. Preparation for disposal at Envirocare
3. Metal melting
4. Decontamination and shipment to Envirocare
5. Preparation for disposal at Barnwell

The types of metals best suited for decontamination for free release include large components, structural members, large diameter piping, high density metal and high value alloys. GTS Duratek uses a wide range of decontamination methods applied to the different metals. Some of these methods include;

- Manual wiping and scrubbing with solutions
- Vacuuming
- Blasting with media (water, ice, CO₂, or sponge)
- More aggressive blasting (grit, shot)
- Rotoblasting and electropolishing, and
- Chemical decontamination

The metal material is sized reduced to optimize the number, size and surface area of the pieces for handling and processing in the decontamination facilities. Metals are cut using a variety of methods such as plasma torches, burning bars, and pneumatic saws.

Metal that cannot be decontaminated for free release or economically disposed at a low-level waste burial site will be melted. The GTS Duratek Metal Melter was the first commercial foundry constructed for the smelting of radioactively contaminated metal in the U.S. The melter is a 20-ton induction furnace capable of producing 10-ton shield blocks used by the Department of Energy.

Concrete Processing

Concrete is processed as shown in Figure 4. Contaminated concrete which meets the Envirocare Waste Acceptance Criteria, will be sized reduced to less than 7-ft X 7-ft X 10-in for disposal. Activated concrete will be packaged for shipment to Envirocare or Barnwell depending on the radiation levels.

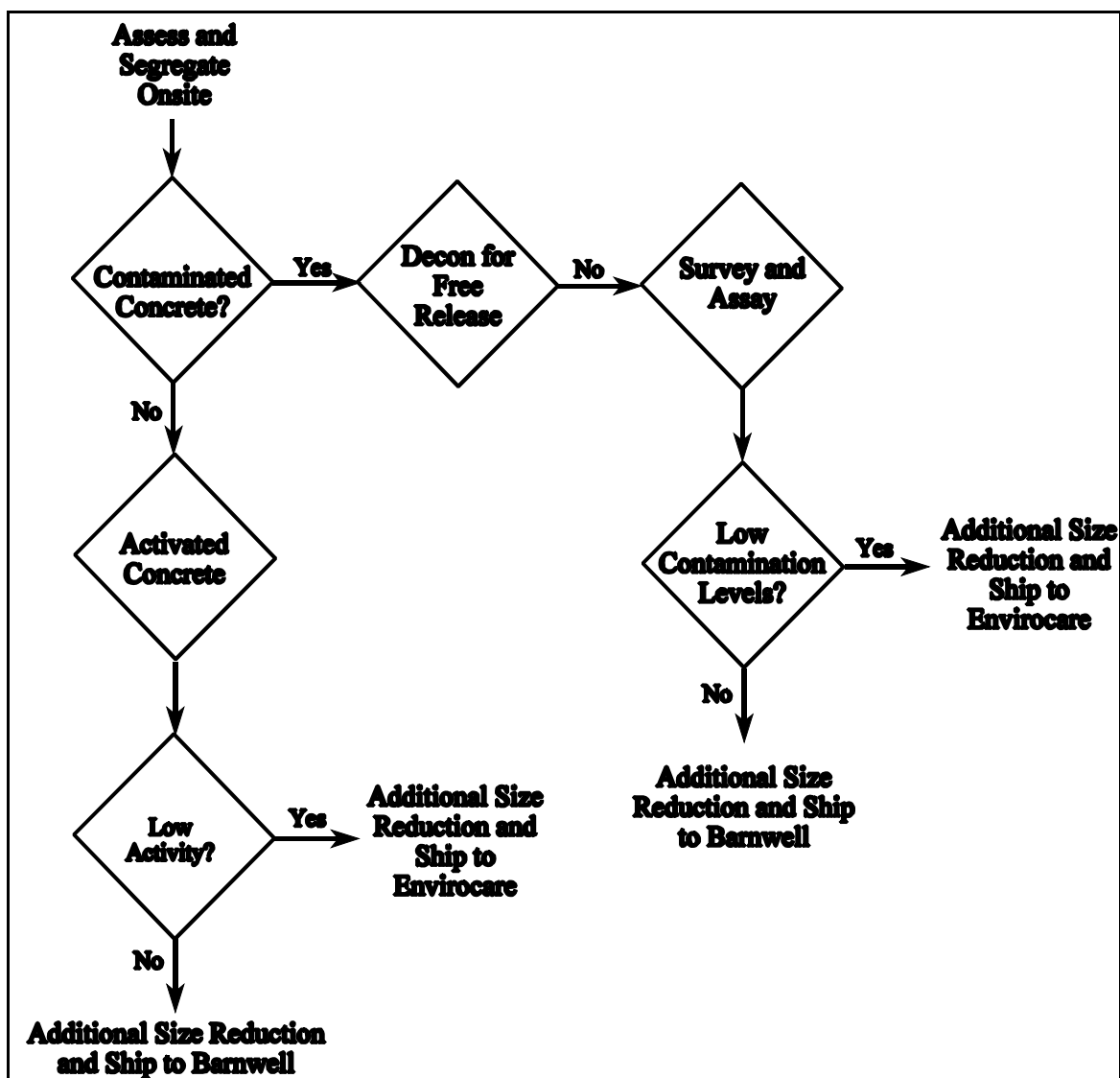


Fig 4. Concrete Processing Flow Diagram

CONCLUSION

Consumers Energy Company began operation of the Big Rock Point Plant in 1962. Thirty Five years later, the plant permanently ceased operations. The plant is now undergoing decontamination and decommissioning activities. GTS Duratek is providing on-site management, packaging, transportation, processing and disposal of the radioactive and hazardous wastes associated with this project. The two companies have developed an integrated on- and off-site approach. The process flow of all waste materials have been determined and are ready to be implemented at this time.

REFERENCES

1. Consumers Energy Company, Big Rock Point Plant, Post Shutdown Decommissioning Activities Report; Revision 1, Docket 50-155, September 1997.
2. GTS Duratek, Amendment 3 to Proposal for Waste Processing Services, Scope of Work, 1998.
3. GTS Duratek, Proposal for Waste Processing Services to Consumer Big Rock Point Nuclear Plant, REFS-97-0069, December 1997.