



DFDX

by Euro Nuclear Services

**Advanced Chemical
Decontamination Processing**



ENS

DFD Chemical Decontamination

Chemical decontamination has been used routinely over the last two decades to free-release components or reduce radiation exposures for operating nuclear facilities. The key challenge in this technology has been to devise effective methods to loosen sludge and crud without compromising system water chemistry with corrosive agents.

More effective processes have been developed for retired plants and components where there is less concern about corrosion. Bradtec Ltd developed the “Decontamination for Decommissioning” (DFD) process to meet criteria established by Electric Power Research Institute (EPRI) and was awarded an R&D 100 award for significant technical development. DFD combines the advantages of applying a dilute chemical solution similar to that used on operating plants (LOMI or EMMAC), and achieves high decontamination factors (over 1000).

DFD Process

- Dilute acid-recirculating decontamination
- Removes metal surfaces micron by micron
- Enhancement by permanganate
- Continuous ion exchange clean-up
- Suitable for in-situ plant systems
- Suitable for ex-situ components

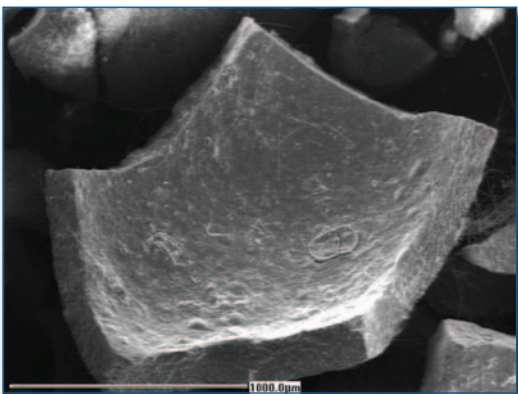
DFD Advantages

- Low secondary waste
- Low chemical use, ion exchange resin waste accommodates the metal removed
- Dilute solutions, low chemical hazard
- No liquid waste; process starts and finishes with clean water

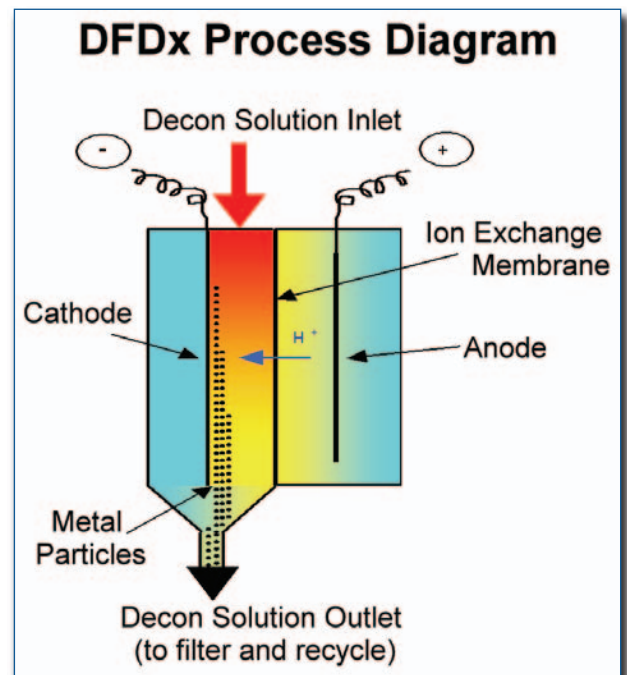
What is DFDx?

DFDx — an enhancement of DFD — generates metallic, rather than ion exchange secondary waste, making it usable for a variety of applications and reducing secondary waste management costs.

Because the final waste form does not include organic components, it avoids hazards of decomposition and gas generation due to radiolysis of the final waste form. Furthermore, operators can readily process the waste into a form suitable for long-term on-site storage (for example, shielded drums).



Metallic deposits generated in the cathode compartment of the DFDx cell.



Adding DFDx to DFD

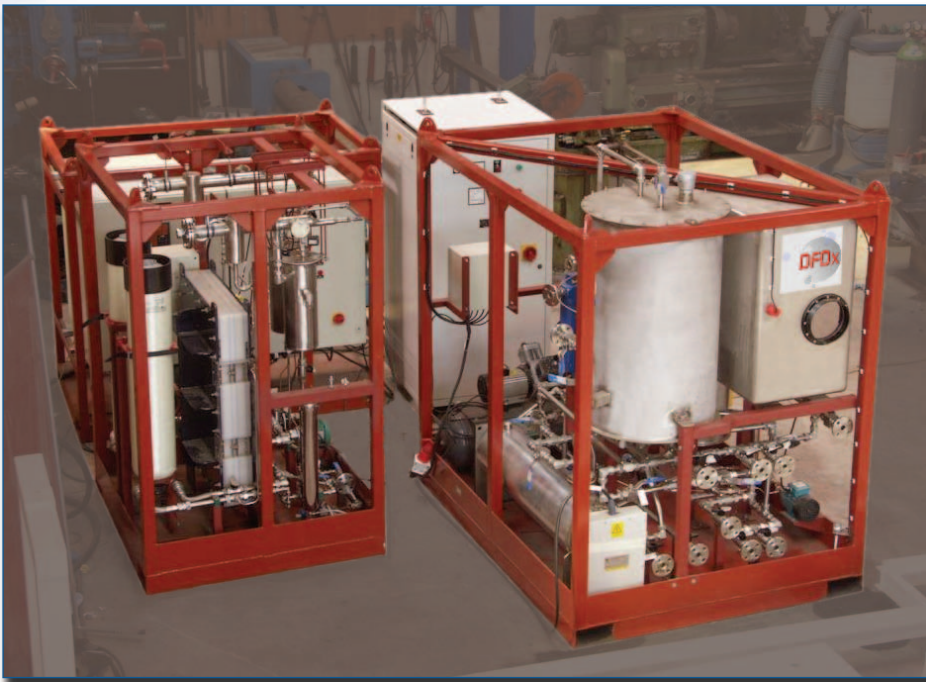
- Metal deposited by electrolysis instead of ion exchange:



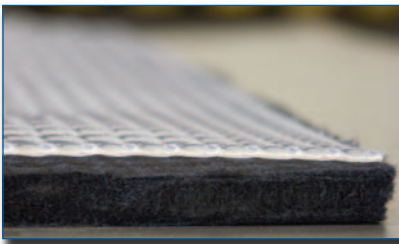
- DFDx unit replaces the cation exchange column, the rest of the process remains the same.

ENS DFDx Plant

- 50 kW power supply
- Porous carbon cell
- Requires just 100 m² area and 3 m³ volume
- Campaign on BWR/PWR artifacts, Studsvik (Sweden)
- Campaign on fuel reprocessing plant components Dounreay (UKAEA)
- Can do DFD or DFDx
- In-situ or ex-situ



The ENS DFDx system utilises porous carbon to collect radioactive cations. Metal particles and radioactivity are retained in a carbon felt structure and the entire felt is discarded on process completion.



New carbon felt

Although porous carbon has slightly greater waste volume, it is more convenient and efficient, can be incinerated, and represents a lower cost of operation.



Metallic deposits generated in the cathode compartment of the DFDx cell.

EPRI DFD Project Statistics

	Big Rock Point (US BWR)	Maine Yankee (US PWR)
Process Time	18 Days	25 Days
Activity Removed	15 Tbq	3.7 Tbq
Metal Removed	575 kg	285 kg
Resin Used	15.2 m ³	15 m ³



Pre- and post-DFDx processing on a steam generator tube section.

Items are typically free-released or easily recycled for controlled use.

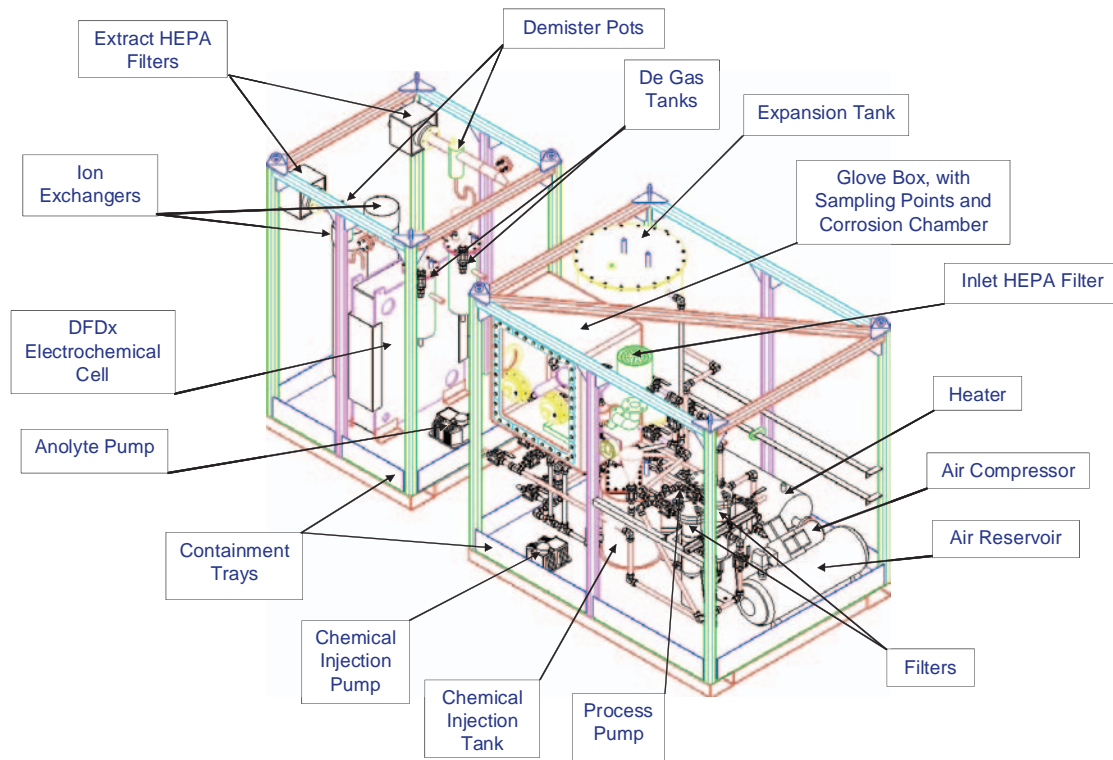
DFDx by ENS

- The DFDx process is owned by EPRI and is offered through ENS Ltd as a turnkey service including material movement, processing, radiological survey, and final disposition.
- ENS has ample capacity to provide DFDx processing for a full range of project scopes.
- Processing operations can be performed on-site or off-site.
- We can engage at any point during a project, from planning to final material disposition.
- Services are available to facilities throughout the Europe.

Potential Applications DFDx Chemical Decontamination

DFDx by ENS

- Steam generators/heat exchangers
- Control rod drives
- Process pumps
- Reactor heads and bolts
- Steel plates
- Piping systems
- Boilers
- Fuel reprocessing systems



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