Holtec’s Spent Fuel Management Technologies

Dr. Stefan Anton, Vice President of Engineering
Holtec International
INMM Spent Fuel Seminar 2018
January 23-25, 2018
Outline

- Holtec International Overview
- Fuel Management Goals
- Regionalized Loading
- Loading Optimization
- Summary
Holtec International: Corporate Profile

- Established in 1986
- Order Book for Future Deliveries: 5.0 Billion USD +
- Impeccable on-time delivery record
- No history of long-term debt
- Self financed company growth
- Highest industrial credit rating [D&B-1R2]
- Business Mix:
  - ✔️ 85% Nuclear power & nuclear waste
  - ✔️ 10% Fossil power-combined cycle
  - ✔️ 5% Renewables - solar, wind, etc.

Holtec Technology Center located in Camden, New Jersey, U.S.A

Holtec is a Vertically Integrated, Innovative Technology Leader with Unique Approaches to Design & Manufacturing
Holtec is a Vertically Integrated Turnkey Supplier of Goods and Services to Clients on Six Continents

- Holtec’s vertical integration spans:
  - Design
  - Engineering and Licensing
  - Fabrication
  - Critical Material Supply
  - Site Installation
  - Construction
  - Operations

- This allows for:
  - Coupling of design, fabrication, and construction
  - Control over quality, delivery, and costs
  - Expedited Delivery
  - Integrated solutions for customers
  - Turnkey projects
Holtec Operation Centers Around the Globe

- Holtec International Corporate Headquarters, Jupiter, Florida
- Singh Center for Nanotechnology, Philadelphia, Pennsylvania
- Holtec Technology Campus, Camden, New Jersey
- Holtec Manufacturing Division, Pittsburgh, Pennsylvania
- Orrvilon Manufacturing Center, Orville, Ohio
- Holtec Asia Manufacturing Center, Dahej, India
- Holtec Asia, Pune, India
- Holtec Satellite Office, Sizewell, United Kingdom
- Air Cooled Systems Project Office, San Diego, California
- Holtec Ukraine, Kiev, Ukraine
- Holtec Africa, Ruimsig
- Holtec Arabia, Dubai
Spent Fuel Management Goals and Technologies

- Overarching goal of spent fuel management is safety
  - ✓ Goal 1: Minimize and/or manage dose to the public and to plant personnel
  - ✓ Goal 2: Move fuel into dry storage in a timely manner

- Holtec’s technologies to address both simultaneously
  - ✓ Regionalized Loading
  - ✓ Loading Optimization Software
Regionalized Loading

All of Holtec’s MPCs offer regionalized loading schemes, where either 2 or 3 concentric regions or groups of cells that are specified with different performance parameters in terms of heat loads, burnups and cooling times.

- HI-STORM 100: 2 Regions
  - Inner – Hotter Fuel
  - Outer – Colder fuel

- HI-STORM FW: 3 Regions
  - Inner – Medium fuel
  - Intermediate – Hotter Fuel
  - Outer – Colder Fuel
Regionalized Loading (cont.)

- Moving hotter fuel away from the basket periphery reduces dose (Goal 1)
- All MPCs operate in vertical orientation with a pressurized internal that very effectively promotes thermosiphon effects (heat transfer through convection) inside the canister. This allows to maintain peak cladding temperatures below safety limits even with hot fuel in the center or intermediate region (Goal 2)
Regionalized loading (cont.)

Typical mistakes (cask loadings not utilizing the benefits of regionalized loading)

✔ Load all cold fuel to reduce dose rate
  ▪ Loading cold fuel in the inner cells will only result in a moderate reduction of dose during loading, but over time deplete the number of cold fuel assemblies available to be placed on the periphery, so it results in higher dose rates later on.

✔ Load all hot fuel to keep cold fuel for later
  ▪ The idea of keeping cold fuel for later is principally correct, but a specifically optimized loading plan is a better alternative than simply loading hot fuel on the periphery with its corresponding high doses.
Spent Fuel Loading Optimization

Holtec has specialized software to develop customized loading plans for our MPCs that address both safety goals:

- Utilizes the fuel inventory to be loaded
- Utilizes the design-basis radiation shielding models for dose projections
- Optimizes loading on a cell-by-cell rather than region-by-region basis
- Allows what-if studies
- Provides validated loading plans
- Provides preliminary crew-dose estimates on a cask-by-cask basis
Summary

- Overarching goal of spent fuel management is safety
  - Goal 1: Minimize and/or manage dose to the public and to plant personnel
  - Goal 2: Move fuel into dry storage in a timely manner

- Holtec’s technologies to address both simultaneously
  - Regionalized Loading
  - Loading Optimization Software