

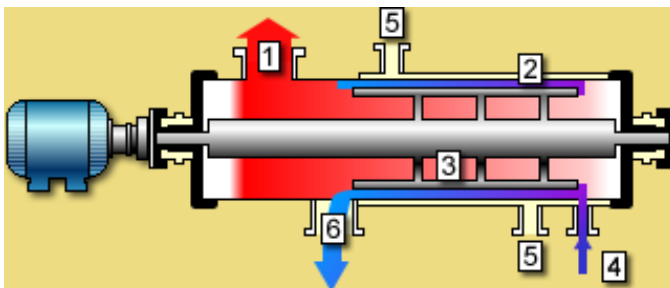
**T H I N F I L M E V A P O R A T I O N**

**Background**

Columbia Energy & Environmental Services (Columbia Energy) has developed nuclear grade thin film evaporator (TFE) systems to consolidate and/or reduce liquid wastes prior to final treatment processing. The systems are offered in both a transportable and permanent configuration. Multiple units can be deployed in series or parallel configurations in order to adjust to varying concentrate and condensate quality requirements (series) or varying processing quantities and rates (parallel). In addition, the TFE system can operate in either a continuous concentration loop or a single-pass evaporation unit operation.



*Portable Thin Film Evaporator Module*



- |                 |                          |
|-----------------|--------------------------|
| 1 Vapor out.    | 4 Feed in.               |
| 2 Process wall. | 5 Heating medium in/out. |
| 3 Rotor blades. | 6 Bottoms discharge.     |

*Thin Film Evaporation Process*

The material fed to the TFE is held as a thin film against the heated wall by means of the centrifugal force exerted by the internal rotor blade, which constantly renews the film as concentrated material is displaced towards the bottoms discharge nozzle by the incoming feed. The amount of material exposed to the heat is minimal (only a film of approximately 1/8" thick), increasing heat transfer and keeping the holdup and residence time very low. The TFE also operates under a vacuum, which reduces the boiling point of water to approximately 120 – 140 degrees Fahrenheit and enables up to 99% evaporation in a single pass through the unit.

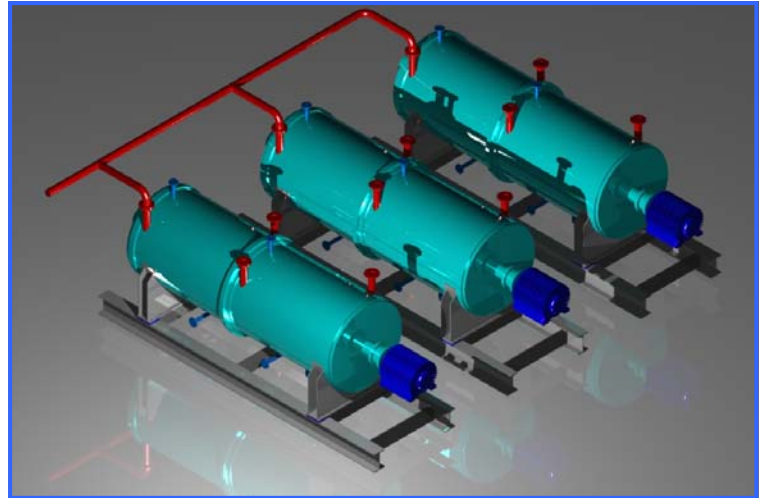
**Advantages**

Advantages of the TFE process for nuclear applications include:

- ▶ Reduced water content **lowers capital costs and operating expenses** by reducing the required storage capacity and size of processing equipment and energy requirements.
- ▶ Vacuum operation reduces the boiling point of water to approximately 120 – 140° F; low temperature operation **limits component carryover** (e.g., organics, salts, etc.) into the vapor.
- ▶ Centrifugal force holds a thin film of material (approximately 1/8 inch thick) against the heated wall; **increasing heat transfer** and reducing holdup and residence time.
- ▶ Low material holdup within the unit **reduces the quantity of shielding** necessary to meet dose exposure constraints; for dilute or low-dose waste streams, self-shielding from the unit itself may be sufficient.

Evaporation rates vary depending upon operational mode, input stream characteristics, desired concentration and TFE size and range from 5 to 50% (pound of condensate per pound of input stream). Systems are sized based upon the deployment configuration and quantity of evaporator condensate produced. Systems are available from 0.1 gpm condensate to 10 gpm condensate with lead times varying depending upon application.

*Permanent Thin Film Evaporator System with Multiple Units*



Columbia Energy maintains a 5,000-ft<sup>2</sup> testing and demonstration facility that includes a pilot-scale (1-ft<sup>2</sup>) countercurrent, TFE to confirm design parameters, overhead characteristics and concentrate handling characteristics. In our testing and demonstration facility, application engineers perform rapid process optimization studies on client waste streams in order to design and fabricate TFE systems to meet specific design, operations, and maintenance criteria.

*Pilot-scale Testing and Demonstration Facility*



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Columbia Energy is a woman-owned full-service engineering company licensed in Washington and Idaho with an audited ASME NQA-1 program that offers a diverse range of products and services, including engineering & design; drafting; environmental & regulatory consulting; technology development & deployment; waste process & groundwater modeling; and IT consulting. Products include a mobile evaporator, low-level waste solidification process, laboratory management system, and hose-in-hose solution. Columbia Energy has a reputation for safely delivering project solutions on time and to budget.

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