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IMPINGEMENT AND ENTRAINMENT- REVISED DRAFT (NOV.) DEFINITIONS

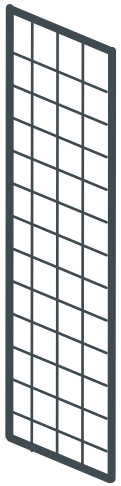
The following definitions are proposed for impingement and entrainment monitoring at cooling water intake structures:

Impingement

Retained on a 9.5 mm (3/8 inch) mesh

- Organisms that are trapped against the screen
- Organisms that are too weak to escape the velocity of the water moving through the screen (< 0.15 m/sec)

Flow

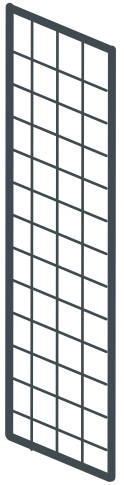


Entrainment

Pass through 9.5 mm (3/8 inch) mesh

- Eggs and larvae
- Small juveniles (those that can pass through the screen)

Flow



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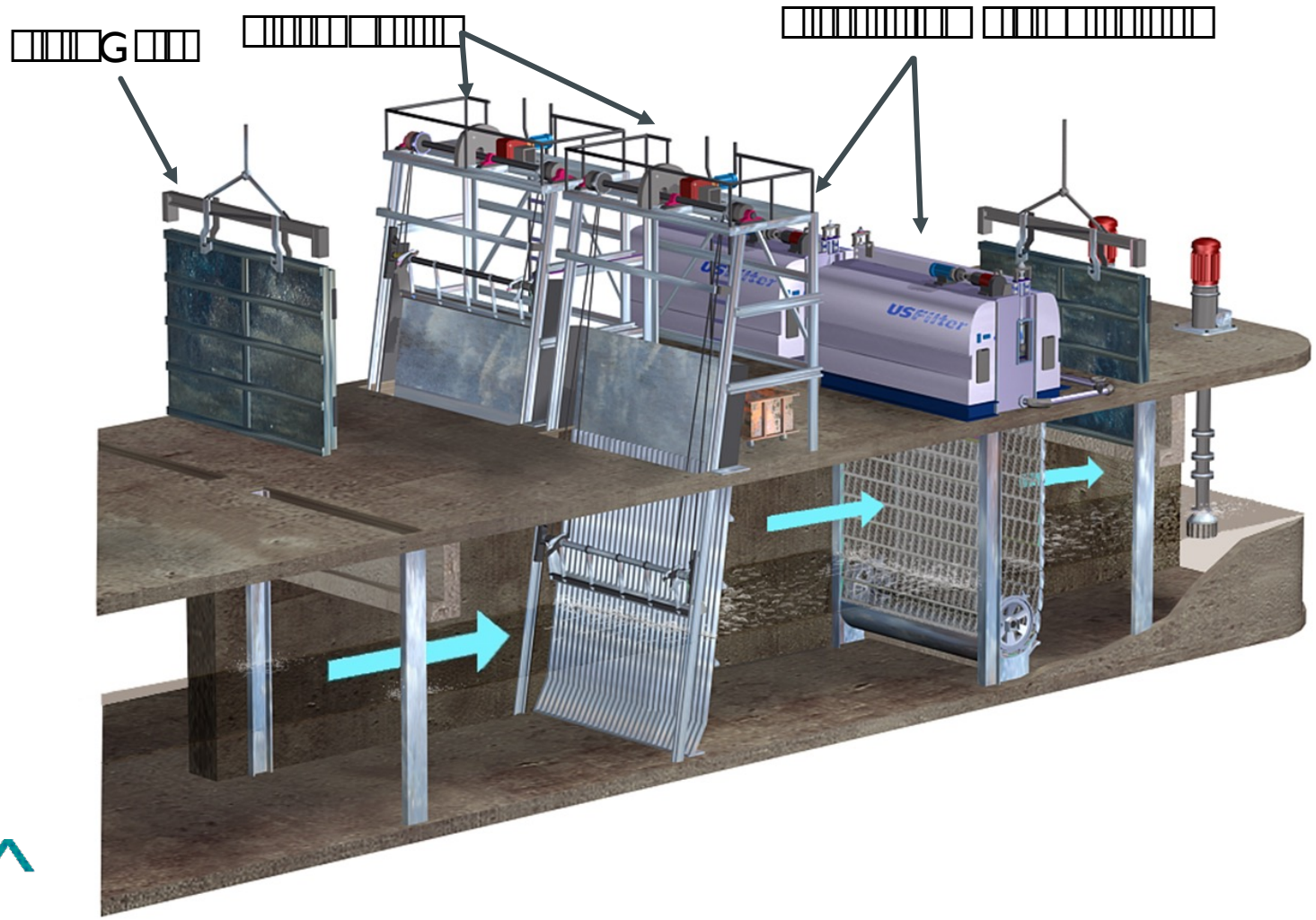
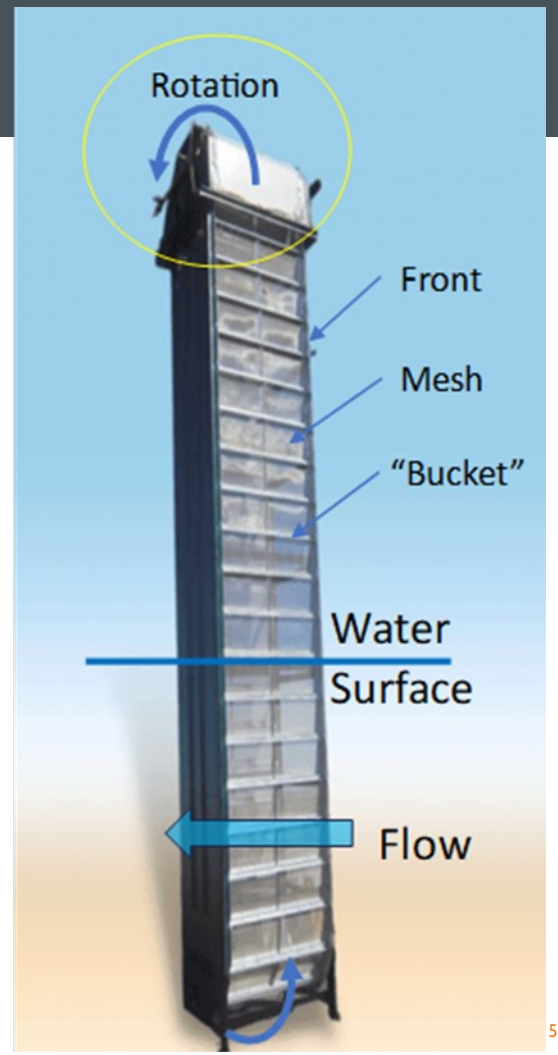
COOLING WATER INTAKE & TRAVELING WATER SCREENS





Traveling Water Screen

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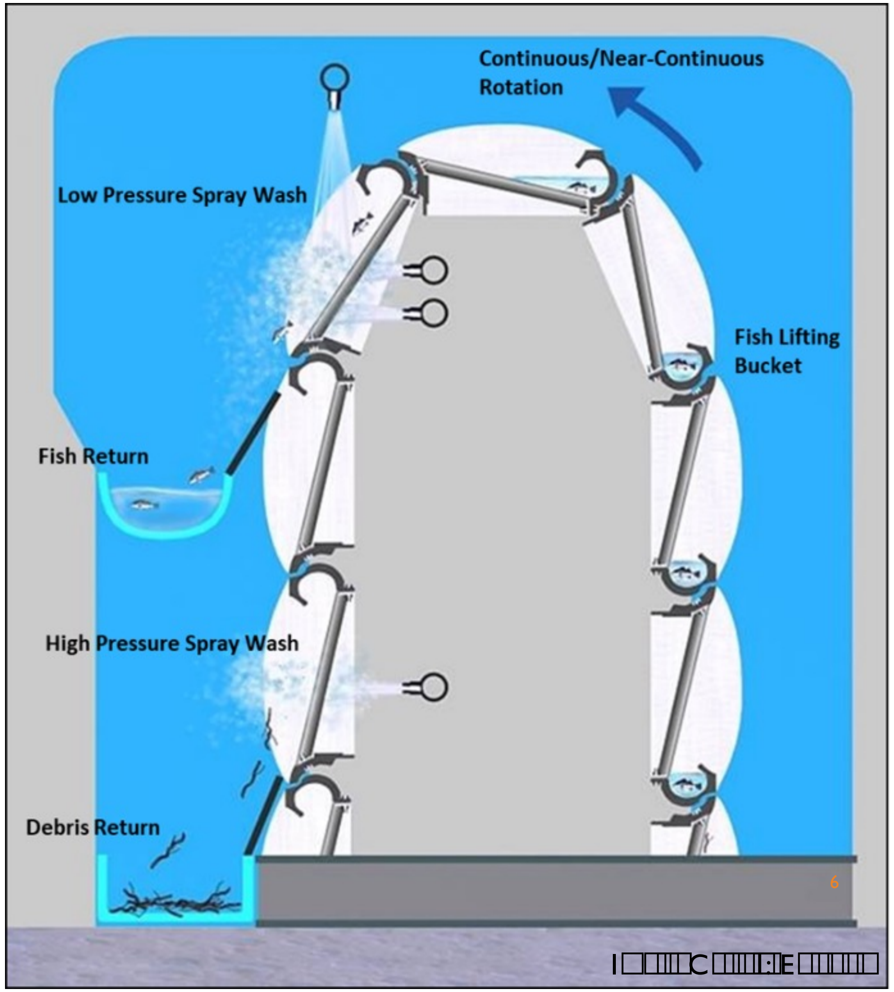
Continuous/Near-Continuous Rotation
Low Pressure Spray Wash
Fish Lifting Bucket
Fish Return
High Pressure Spray Wash
Debris Return

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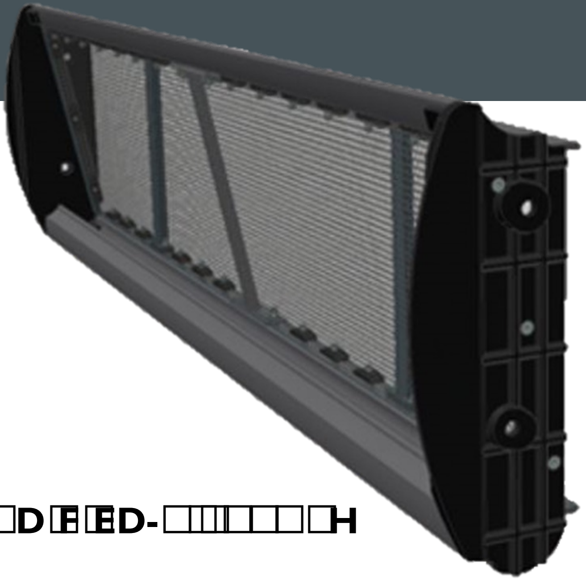

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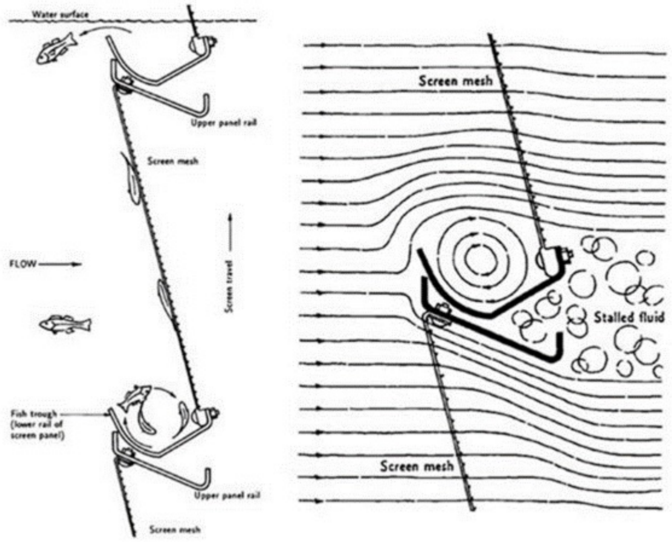

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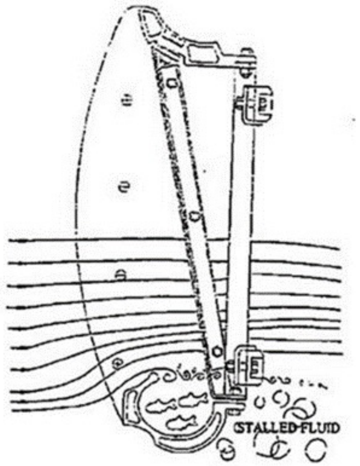

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TRAVELING WATER SCREEN RESEARCH – LABORATORY

- EPRI evaluated mortality, injury, and scale loss related to interaction with MTWS
- Ten species of juvenile freshwater fish (50-100 mm)
- Three approach velocities 0.3, 0.6, & 0.9 m/s (1, 2, & 3 fps)
- Some Key Findings
  - Mortality was low regardless of species or velocity (<5%)
  - Injury rates were variable by species and dominated by fin damage (40%), bruising or hemorrhaging (30%), and disease or fungus (20%)
  - Scale loss variable by species and linked to scale type
  - Mortality, injury, and scale loss generally increased with water velocity, but velocity was only a significant predictor of mortality for bluegill ($p<0.05$)

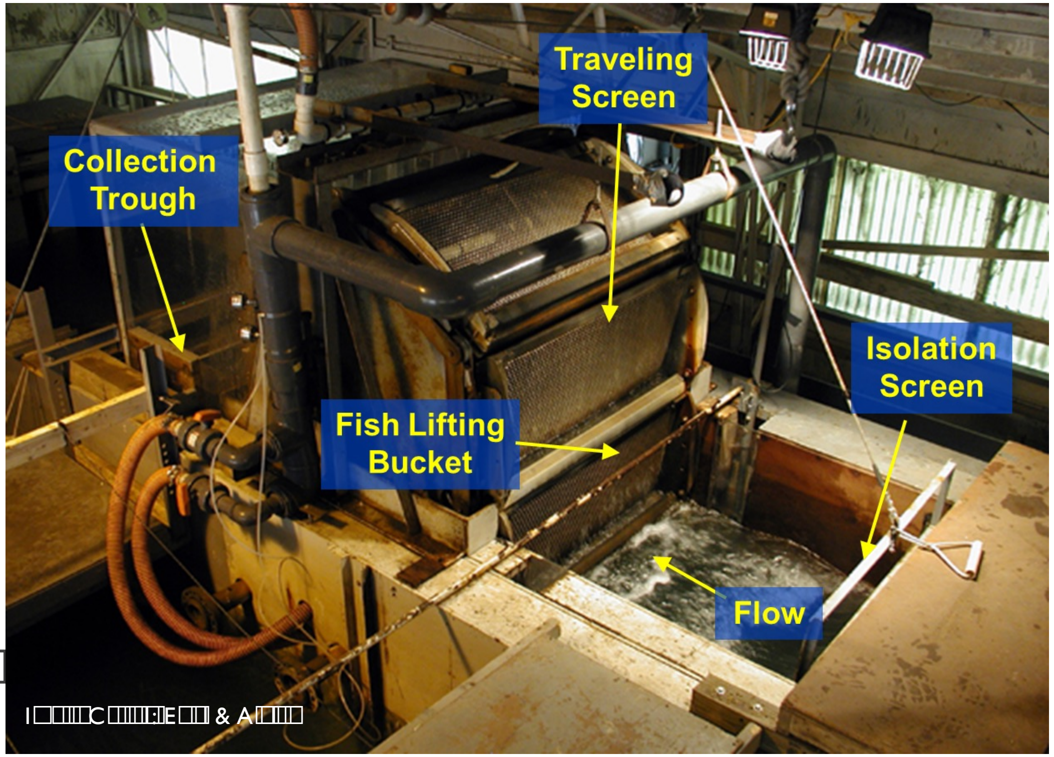

Image Credit: EPRI & Alden

TRAVELING WATER SCREEN RESEARCH – LABORATORY

Video Credit E

Golden Shiner and White Sucker 0.3 m/sec

- Discredited Assumption
  - Fish are drawn in and held against the screen mesh
  - Fish are unable to overcome the high velocities to escape or seek refuge
- Video observations identified three paths to collection
  1. Impinged briefly then wiggle to bucket
  2. Tail tapped followed by burst swim then scooped by bucket at surface
  3. Sought refuge in bucket w/o screen interaction
- Important to note the flow velocities (0.3 m/sec) and juvenile size of fish (50-100 mm).

EVALUATING TRAVELING WATER SCREEN RESEARCH – FIELD: SOUTHERN U.S.

- EPRI evaluated the rate, mortality, and health of fish impinged at two southern U.S. power plants
- Multi-year study evaluating conventional screens and MTWS.
- Evaluated various MTWS operating parameters to optimize fish survival
- Some Key Findings
  - Mortality varied by MTWS operating parameters with no clear optimal condition
  - Impingement mortality varied seasonally and with water temperatures (i.e., high mortality in summer months)
  - Survivability and fish health assessment identified that most impinged catfish were of compromised health.

Image Credit: EPRI & Alabama Power Company

Image Credit: EPRI & Alabama Power Company

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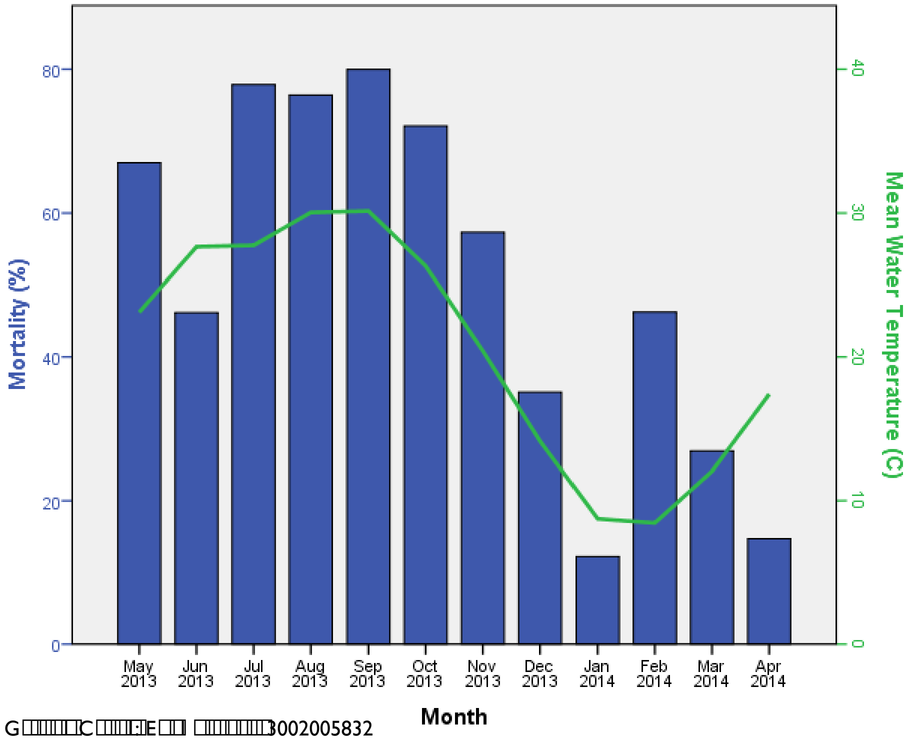

Graphic credit E□□ Product 002005832

Relationship Between Impingement Mortality Rates and Mean Water Temperatures at Southern U.S Power Plant

- Discredited Assumption
  - Fish of good health are impinged throughout the year
- Mortality highest in late summer at maximum water temperatures and decreased in fall under cooler temperatures
- Health assessments reported the prevalence of fish disease was strongly correlated with water temperatures

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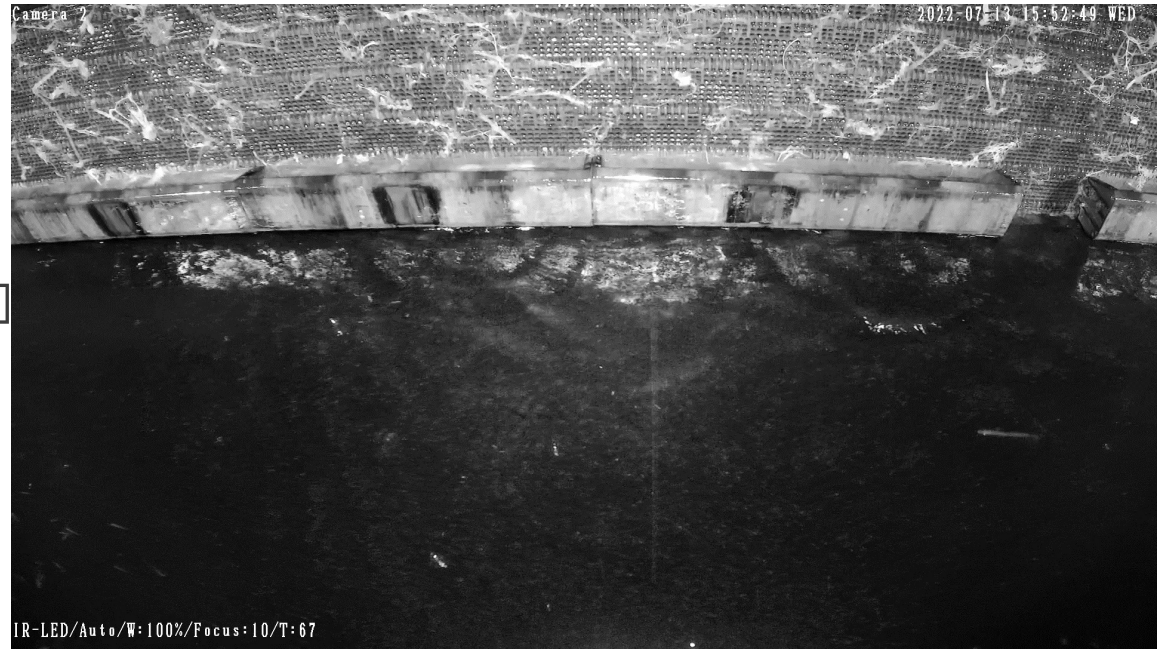

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SUMMARY – IMPINGEMENT ASSUMPTIONS vs RESEARCH FINDINGS

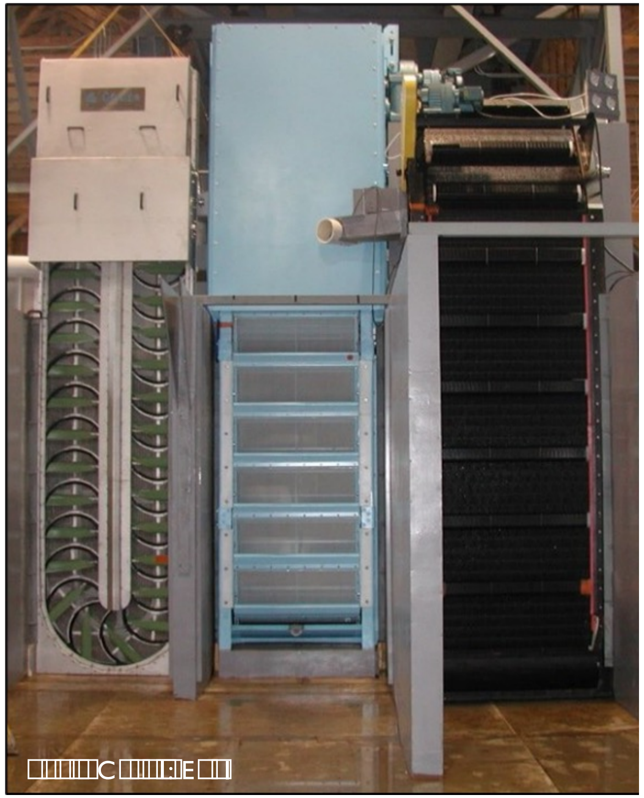

Photo Credit: E[illegible]

- Fish are drawn in and held against the screen mesh
  - Research findings indicate that fish do not impinge in the traditional sense
  - Various behaviors have been observed, many result in bucket collection
- Fish are unable to overcome intake velocities to escape or seek refuge
  - Allow approach velocities (≤ 0.6 [illegible]/[illegible]) juvenile fish have been observed swimming freely in front of screens and seeking out low hydraulic zones
- Fish of good health are impinged throughout the year
  - Impingement of fish with poor health during extreme water temperatures
- Fish of various species are continuously impinged at high numbers throughout the year
  - Impingement is episodic by nature
- Continuous rotation of screens is ideal for fish collection and survival
  - Rotating the screen continuously may have a higher rate of collection than stationary
  - A topic of continued research for: [illegible].

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