USGS Upgrading and Refurbishing of Secondary Cooling System and Air Monitor

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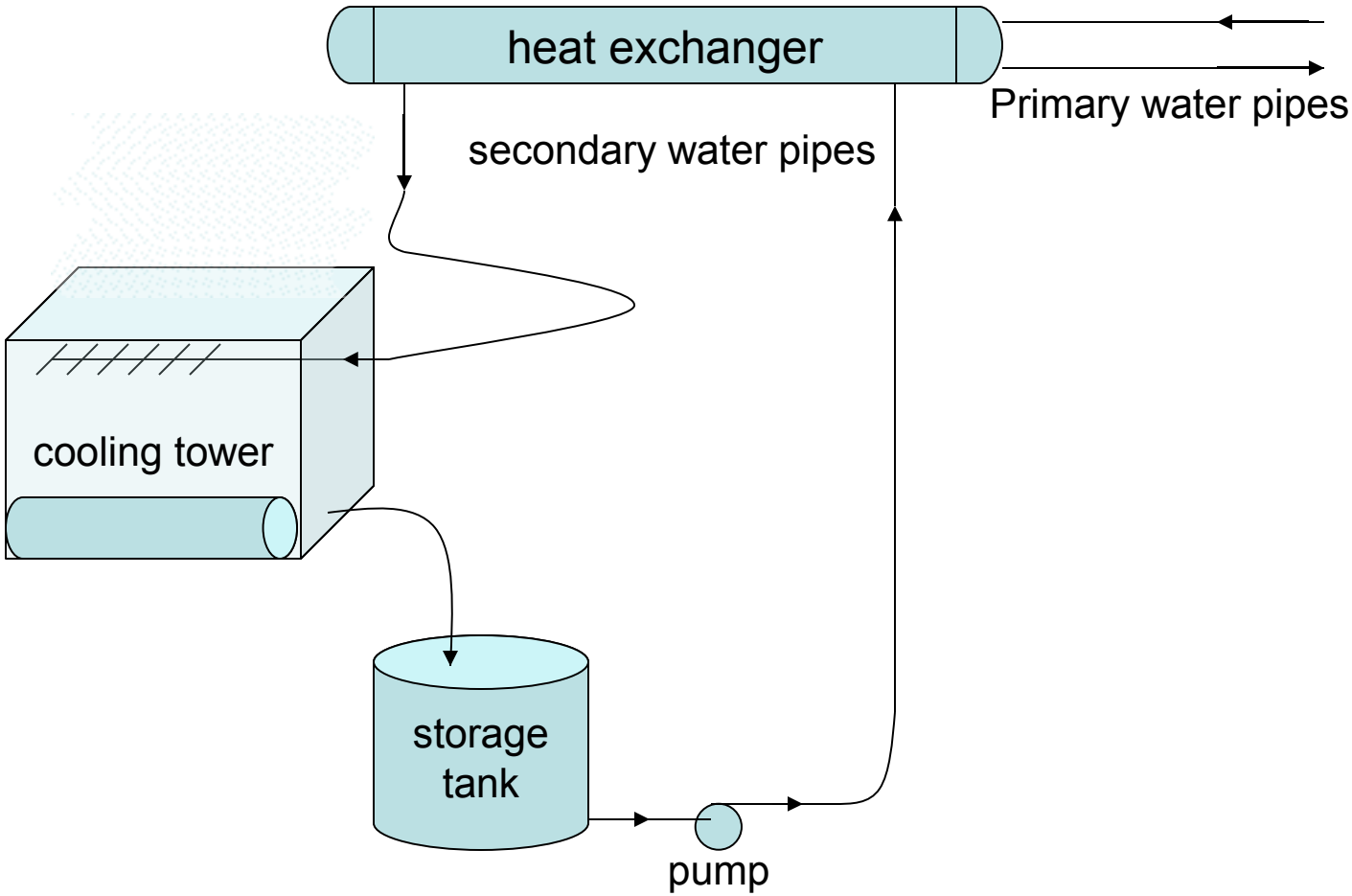


Secondary Cooling System Line Diagram

Secondary Cooling System Original Specifications:

- nominal water flow at 700 gpm
- single stage vertical turbine pump w/30 hp electric motor
- counterflow evaporative cooling tower
- four squirrel cage fans powered by 20 hp electric motor
- fan bearings were oil-lubricated, bronze bushings
- tower fill was asbestos-based
- tower structure was of hot-dipped galvanized steel
- spray nozzles are polypropylene, cleanable, mounted on 6” centers
- rated to cool 1 MW TRIGA facility

Secondary Cooling System Renovation Tasks:

- clean, sandblast, paint, and coat inside of 3000 gal tank
- replace secondary pump and motor
- refurbish cooling tower:
    - · clean spray nozzles
    - · sandblast interior, regalvanize, apply coating
    - · replace asbestos fill with PVC fill
    - · replace fan bearings and shaft

Secondary tank refurbishment:

- 3000 gallon tank was emptied, sandblasted, and coating applied
- significant oxidation was present and several holes needed patching
- interior coating was flame-sprayed polyethylene
- coating basically built a tank within the steel tank
- tank was flushed before using after work

Conclusion:

- cost was $4760 and five days shutdown
- tank has performed well for ~ 15 years since the work

Secondary pump and motor replacement:

- original motor was 30 hp
- new pump was ~10% more efficient; 25 hp electric motor used
- adapter plate was needed to mate new pump to old mounting bolts
- ~10 months later the pump flow dropped dramatically
- troubleshooting showed the “sand collar” had become loose and was partially blocking the impeller suction.
- repair was done under warranty but cost another day shutdown

Conclusion:

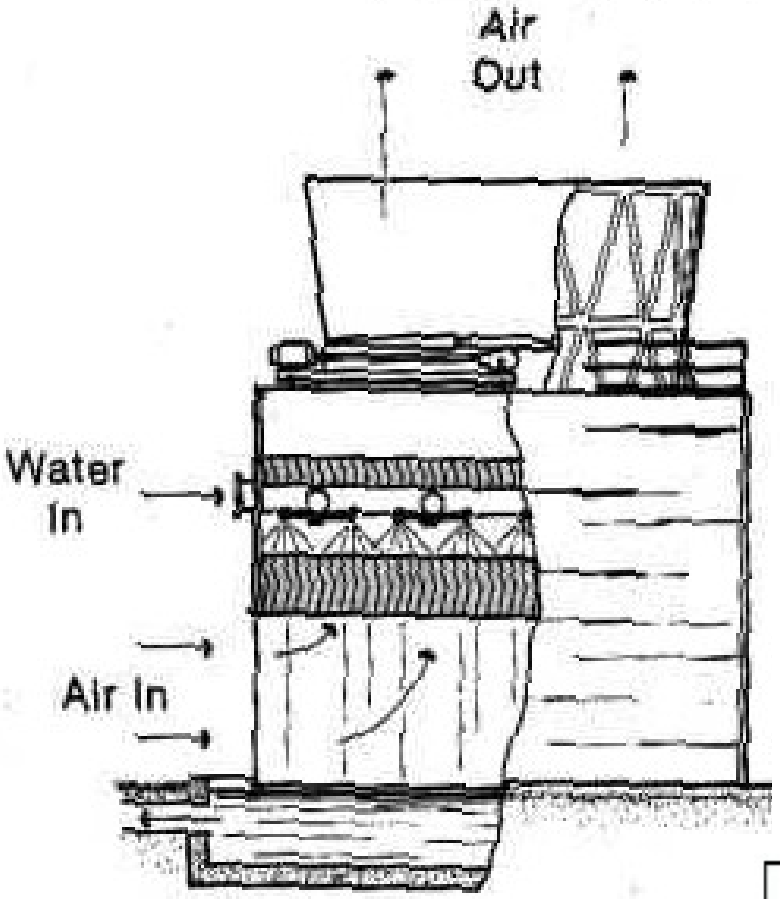
- cost was $4560 and one day shutdown
- pump and motor have worked well after collar replacement

Cooling Tower Refurbishment:

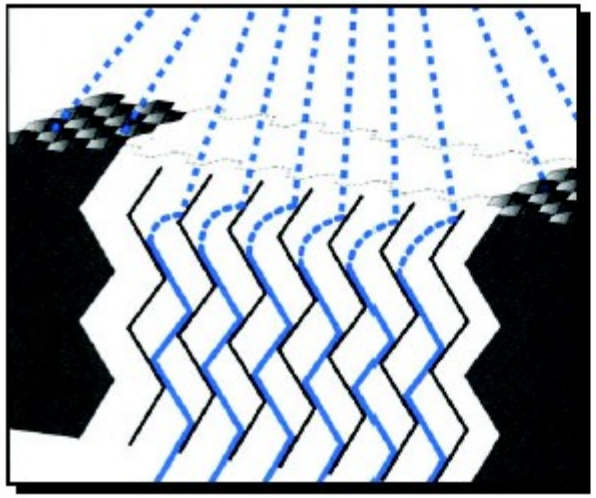
- first job was to get rid of asbestos-containing fill
- asbestos removal took 2 days and cost $4000
- tower interior was then sandblasted, a hole patched, and regalvanized
- interior was then coated with a urethane coating
- shaft and bearings for four squirrel cage fans were replaced
- new PVC fill was installed
- interior was cleaned, and access holes sealed
- pump was started and spray nozzles cleaned
- site cleanup found dust pan and foxtail brush missing (in tower)
- tower was reopened, pan and brush removed, and resealed
- post-job tests showed air flow from fans decreased by ~30%
- fan inspection showed squirrel cage units installed backwards
- fans were removed, turned around and reinstalled
- one drift eliminator was damaged by contractor and replaced

CONCLUSION:

- cost was $14,830 and 7 days shutdown
- subsequent data show ~25% increase in cooling capacity of tower
- primary water temperature is now about 8°C lower than before
- another benefit is ion exchanger resin now lasts about twice as long



Counterflow cooling tower

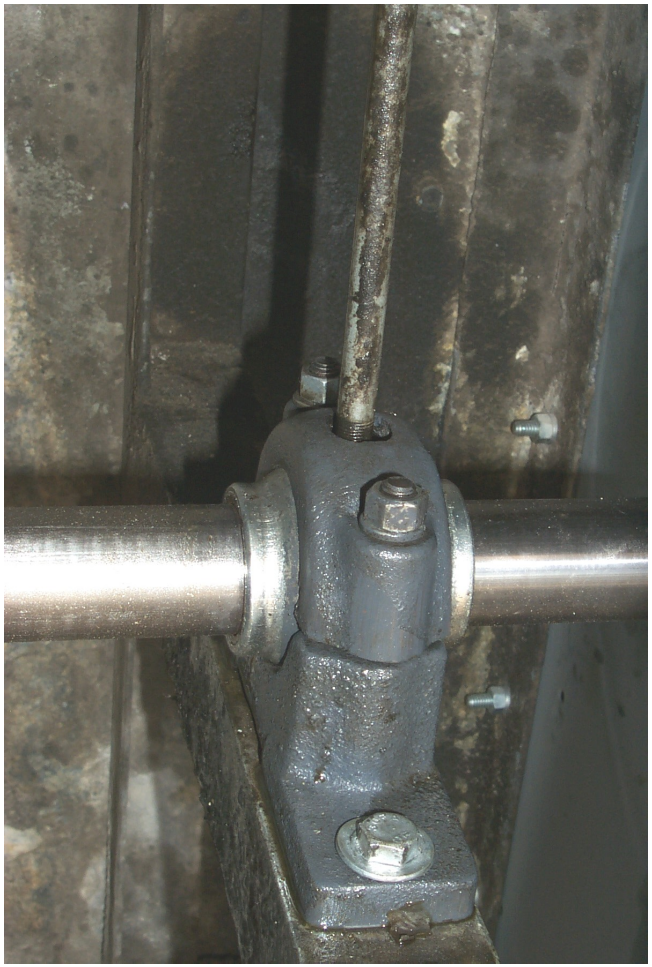


Film-Type Fill

Film-type fill distributes thin, even layers of water for maximum air exposure and cooling efficiency. PVC construction resists decay, corrosion and microorganisms, plus handles temperatures to 130°F.

Old Fill From Cooling Tower

New Fill Being Installed In Cooling Tower



Fan shaft and bearing

Spray nozzles on cooling tower
(note nozzles on left are plugged)

Moving Squirrel Cage Fans From Cooling Tower

Replacement of electronics in continuous air monitor (CAM)

- original CAM was an NMC model AM-2A with a thin, end-window GM detector
- original electronics included low and high setpoint alarms and ratemeter
- original electronics were 1967 vintage discrete components
- CAM was exhibiting significant daily calibration drift
- replacement parts were hard or impossible to find

GSTR Technical Specifications

- reference the CAM in sections F.2 and F.3:

-A continuous air monitor with readout and audible alarm shall be operable in the reactor room when the reactor is operating.

-The alarm set points for the above radiation monitoring instrumentation shall be verified at least once a week. This instrumentation shall be calibrated at least once a year.

Comparison of CAM Electronics Systems

SYSTEM	Warm-up time	Switch controls	Input power require ments	Physical dimensions	Other adj. parameters	Battery backup	Alarm options	Discriminator	RS232 capable	Test circuit	Built-in scaler
NMC - CRM51M	15 minutes	Power, HV, reset, mode	12 watts	18.75"x8.87 5" x 14"	none	No	None	Yes, not adjustable	No	Yes, 3600 cpm	No
Ludlum 375	none	Power, reset, constants	10 watts	18.75"x8.87 5" x 4.5"	calib & decay constants	Yes, 48 hrs	latch/non-latch, single beep/con-stant	Yes, adjustable	Yes	None	Yes, 5 time periods

Ludlum Measurements, Inc, provided custom-modified Model 375 monitor mounted on a face plate to meet USGS specifications for the replacement electronics.

Original CAM electronics

Replacement CAM electronics

CONCLUSION:

-Replacement of CAM electronics was done for a total cost of $1875 and one day of shutdown time.
-Replacement was performed by reactor staff.
-The CAM has worked well in the ~5 years since the upgrade.
-The system is very stable, easy to operate and easy to calibrate