INSTALLING METEOROLOGICAL MONITORING TOWER AT PROPOSED AND EXISTING NUCLEAR FACILITIES

Murray and Trettel, Inc.
Mark T. Carroll
Andrew J. Lotz
Heather A. Cramond

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Introduction:

Meteorological monitoring towers are often the first physical structures evident at proposed green field nuclear sites. New construction at existing nuclear facilities may necessitate the moving of a meteorological monitoring tower due to space considerations or the impact the new construction may have on meteorological measurements. Aging towers may need to be replaced if they have not been properly maintained.

Tower siting considerations, power and communication issues must be addressed before construction can begin. Other tower construction management tasks that need to be considered include FAA and FCC considerations, site access, local and state permitting and tower engineering based on soil conditions

Need for a meteorological monitoring tower at a nuclear facility:

The introduction to U.S. Nuclear Regulatory Commission, Regulatory Guide 1.23, Revision 1, Meteorological Monitoring Programs for Nuclear Power Plants, states the following concerning need for a meteorological monitoring tower:

"…each nuclear power plant site has multiple needs for an onsite program to measure and document basic meteorological data. These data may be used to develop atmospheric transport and diffusion parameters that, with appropriate atmospheric dispersion models, may be used to estimate potential radiation doses to the public resulting from actual routine or accidental releases of radioactive materials to the atmosphere or to evaluate the potential dose to the public and control room as a result of hypothetical reactor accidents. These data may also be used to assess nonradiological environmental effects resulting from construction or operation of a nuclear power plant, such as the impacts of the plant's heat dissipation system."

Concerning the application process for a proposed nuclear facility, Regulatory Guide 1.23 states, "The minimum amount of onsite meteorological data to be provided at the time of application (1) for a construction permit is a representative 12-month period; (2) for an operating license is a representative consecutive 24-month period, including the most recent 1-year period; and (3) for an early site permit or a combined license that does not reference an early site permit is a consecutive 24-month period of data that is defendable, representative and complete, but not older than 10 years from the date of the application. However, 3 or more years of data are preferable and, if available, should be submitted with the application."

Due to the fact that a consecutive 24-month period of on-site meteorological data is required for an operating license, the meteorological monitoring tower can often be the first visible structure at a potential nuclear facility.

Siting of the meteorological monitoring tower:

NRC Regulatory Guide 1.23 as well as ANS/ANSI 3.11, Determining Meteorological Information at Nuclear Facilities, 2005, provide guidance on siting a meteorological monitoring tower at a nuclear facility.

The meteorological monitoring tower should be located at an elevation near that of the finished plant grade. Topography and obstructions (manmade or vegetation) must be considered.

Concerning wind sensors, Regulatory Guide 1.23 indicates that "The sensors should be located over level, open terrain at a distance of at least 10 times the height of any nearby obstruction if the height of the obstruction exceeds one-half the height of the wind measurement."

To provide accurate temperature measurement, the tower should not be located near heat or moisture sources such as large parking lots or water bodies. At a proposed nuclear facility, one would not want to place the tower so close to the proposed plant site that construction activities could impact the meteorological measurements. Also, meteorological towers should be located in areas that are not likely to have future construction or would be prone to having heavy vegetation growth.

Other tower siting considerations would include accessibility, not only for the construction of the tower but for maintaining the tower and the meteorological equipment once the tower is erected and providing data.

Specific tower location:

After siting criteria has been considered, the exact tower location can be determined. The precise tower location is required for surveying the site and for locating where soil borings will be performed. The soil borings are required for tower engineering.

If filing with the FAA for a Determination of no Hazard to Air Navigation, the precise latitude and longitude (North American Datum 83) will be required.

Once the tower location is determined, the site should be marked to show the tower location as well as tower guy anchor locations.

Tower height considerations:

Per Regulatory Guide 1.23, wind speed, direction and vertical temperature difference should be measured at/between heights of 10 and 60 meters (33 and 197 feet). Other measurement heights may be appropriate, especially for stack releases.

Any tower whose height will exceed 200 feet will require a Federal Aviation Administration Obstruction Evaluation/Airport Airspace Analysis (OE/AAA). FAA forms 7460-1 and 7460-2 can be filed electronically via an FAA website or via postal mail.

Code of Federal Regulations Title 14 Part 77.9 states that any person/organization who intends to sponsor any of the following construction or alterations must notify the Administrator of the FAA:

- any construction or alteration exceeding 200 ft above ground level
- any construction or alteration:
  a. within 20,000 ft of a public use or military airport which exceeds a100:1 surface from any point of the runway of each airport with its longest runway more than 3,200ft
  b. within 10,000 ft of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway more than 3,200ft
  c. within 5,000 ft of a public use heliport which exceeds a 25:1 surface
- any highway, railroad or other traverse way whose prescribed adjusted height would exceed the above noted standards
- any construction or alteration located on a public use airport or heliport regardless of height or location.

If it is determined that the meteorological tower will be an obstruction to aviation, FAA Advisory Circular 70/7460-1K, Obstruction Marking and Lighting, describes the standards for marking and lighting structures such as buildings, chimneys, antenna towers, storage tanks, supporting structure of overhead wires, etc. FCC form 854 would also need to be completed.

An FAA obstruction determination may take 30 to 60 days and may impact the tower construction schedule.

Meteorological equipment:

Once it is determined that a meteorological monitoring tower will be erected, the meteorological equipment can be procured. The data logging equipment can also be purchased at the same time.

Table 2, Meteorological System Accuracies and Resolutions, of NRC Regulatory Guide 1.23, Revision 1 should be utilized when determining which equipment will be purchased. Only equipment that will meet the system accuracy and measurement resolution criteria found in

Table 2 should be purchased. Today's digital dataloggers can easily handle measurement resolution guidance.

Shelter:

If a shelter is required, that should be purchased early in the process as it will need to be designed, built and shipped.

Things to consider when purchasing the shelter include size (length, width, height), electrical outlets, HVAC considerations, door location, overhead hangers, etc.

Shelter drawings will be included in the construction documentation.

State and local construction permitting:

Before tower construction work can begin, state and local permitting requirements must be considered. This will vary by state and municipality. Working with a local construction contractor can be beneficial as they would be familiar with any construction permitting requirements.

Excavating, digging, electric, telephone, concrete construction, building (if a shelter is being installed) are some tower construction activities that may require local permits.

Local government and emergency response departments should be notified of the construction location so that they can respond promptly in the event of an emergency.

For green field sites, the property owner must be kept informed of on site activities during the tower construction phase.

Soil borings:

Prior to the soil boring activities, have the site checked for underground utility and pipeline locations. Most states provide a free service that will survey the site for excavation construction obstructions.

A geotechnical company will be required to perform the soil borings and to provide boring data. Soil borings are required to determine what type of soil will hold the tower base and guy anchors. This information is critical for tower engineering. The geotechnical company will provide the soil boring data to the company that will design and construct the tower.

Soil borings should be taken at the tower foundation and guy anchor foundation locations.

Vegetation removal and excavation:

If necessary, a contractor that is capable of removing vegetation and trees from the tower location may be required. Once the tower location is determined, a survey of the area surrounding the tower should be performed to determine potential obstructions to wind (high bushes in close proximity to the tower, trees, etc.).

Use NRC Regulatory Guide 1.23, Revision 1 guidance to determine how much vegetation and tree removal is required.

If large trees must be removed from the site, it may be worthwhile finding a company that will interested in collecting and retaining the trees for commercial purposes. This may reduce the removal cost.

Once the tower construction site excavation is complete, the site should be made accessible to 2 wheel drive vehicles. Access by 2 wheel drive vehicles is preferred not only for the tower construction phase but for calibration and routine maintenance activities that will need to be performed once the meteorological tower is operational.

In order to make the site accessible to two wheel drive vehicles, additional excavation may be required. The distance from roads (paved or gravel) will determine the required length of access roads. Gravel may be required for the access road in order to make the site accessible.

Select and purchase the tower:

Once the soil boring data is available, it can be provided to the tower manufacturer. The subsurface data is required for the tower manufacturer to engineer and design the tower. The tower manufacturer should design the tower to meet EIA/TIA/ANSI-222 XXXXXXXXXXX standards.

Other tower information required for the tower engineers include, height, width, climbing mechanisms, whether or not the tower will have an elevator, weight load of meteorological equipment and antenna weight and tower location if applicable.

The EIA/TIA/ANSI-222 standards have wind criteria for each county in the United States. The tower will be engineered based on those standards.

The tower manufacturer will provide an assembly drawing so that the tower and guy anchor bases can be excavated and prepared for the concrete pour.

Site survey:

A surveyor should be employed to map the exact tower location. The surveyor should mark the tower foundation location as well as the guy anchor locations. The site survey should also include the location of the following if they apply – shelter, rain gauge pad, generator pad, etc. The site survey should be included as part of the construction documentation.

Excavation:

Using the site survey, excavate the tower foundation, guy anchor foundation, rain gauge pad, shelter pad, and solar panel pad (if applicable).

Forming for concrete including rebar for foundations is then completed to prepare for the concrete pour.

Concrete:

When the concrete is poured, keep a record of the pour. Perform a slump test and make five concrete cylinders for testing. Perform inspections and checks on the foundation anchor placement.

Allow the concrete to cure. Cylinder cracking should verify that the concrete has cured to a minimum of 3,000 pounds per square inch.

Once the concrete work is completed, backfill the area surrounding the tower.

Tower erection:

After the tower foundation and guy anchor foundation concrete has cured, the tower can be erected.

The tower should be grounded to meet TIA/EIA standards.

Guy wire tension and tower plumb and twist should be inspected.

Electric power:

If the tower is in a remote location, the local electric company may need to provide service to the site. Additional cost may be incurred if the site is removed from existing electrical service.

Electric poles may need to be installed to bring power to the site from a nearby (or possibly not so nearby) road.

Solar power may be an option for power, especially in locations in the southern United States. Meteorological equipment, data loggers and cellular modems can generally be run off of batteries that are charged during the day by solar panels. In more northern climates where heating wind sensors and rain gauges is a concern, a much more extensive and expensive solar system would be required. If the tower is over 200 feet high or is required to be lighted by the Federal Aviation Administration, additional power concerns will exist.

Communications:

Several means of getting data from the meteorological tower to the plant are available. The link can be hard wired (copper or fiber), radio frequency, dial up telephone lines, cellular connection, etc.

For land lines, the local phone company will need to bring the lines to the site. Underground cables (or overhead lines) can connect the meteorological monitoring site to the plant.

Security fencing:

Security fencing should be placed around the tower foundation, guy anchors and shelter. The fencing should be at least 6 feet high and have barbed security wire at the top.

Engineering:

It is important to note that the meteorological system documentation (including the tower, data logger, communications, meteorological equipment, shelter, generator, solar panels, etc.) may need to meet the requirements of the site engineering group. In some cases, the site engineering group may not have the ability to review the meteorological system documentation in a timely manner. This may lead to the client hiring a contract engineering company to oversee the site documentation of the new meteorological system. Some firms may not be familiar with meteorological systems but they are generally well versed on what the site engineering requirements are for system documentation.

A great deal of time may need to be spent explaining various aspects of the new meteorological system. This should be planned for accordingly. Providing sensor documentation and manuals for various components may not be enough information to meet the needs of the engineering group.

REFERENCES

ANSI/ANS 3.11-2005, American Nuclear Society, Determining Meteorological Information at Nuclear Facilities.

ANSI/TIA-222-G-2005, Telecommunications Industry Association, Structural Standard for Antenna Structures and Antennas.

Code of Federal Regulations, Part 77, Obstruction Evaluation/Airport Airspace Analysis (OE/AAA).

Com Train, LLC, Basic Tower Construction, 1999,

Federal Aviation Administration, Advisory Circular 70/7460-1K, Obstruction marking and Lighting.

U.S. Nuclear Regulatory Commission Regulatory Guide 1.23, Meteorological Monitoring Programs for Nuclear Power Plants, Revision 1, 2007