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Attachments: Representative and Important Species Checklist 2007-02.doc; Updated Guidance on Aquatic + Terrestrial Sections - Word Version - 2.doc

Attached is our informal guidance for writing ecology sections.

NRR has generally followed the "Harvard system of referencing" in its SEISs, with some variations though time and among authors. The Harvard system is used internationally for all kinds of publications, theses, and papers.

Harvard system style guide, including referencing, is available at:

<http://libweb.anglia.ac.uk/referencing/harvard.htm>

Many other universities also post copies of it. This guide is pretty complete and should answer most of our common questions

For us biologists, the American Fisheries Society uses the Harvard system in its publications. The AFS style guide has the same Harvard style for references as in the link above, but also has many biology-related examples.

-Dennis

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Representative and Important Species (RIS) Life History Checklist

(1) Why is this species included?

- Recreationally important
- Commercially important
- High vulnerability to power plant
 - Life stage(s) that are vulnerable (e.g., pelagic eggs)
 - Behavior (e.g., vertical migration to hold place in estuary in front of plant)
 - Distribution (onshore-offshore, depth)
 - Residence (is it a resident species?)
 - Thermal requirements
- Biologically important
 - Forage species supporting other RIS
 - Carnivore possibly controlling size of other populations
 - “Keystone species”
 - Rarity or unusual attribute

(2) Autecology

- Describe the life stages
- Typical life span
- Size at important stages
- Migratory patterns
- Reported population size for different life stages, seasons, or years
- Trends or cycles in abundance
- Fecundity (and life history strategy that affects vulnerability—e.g., r/K selection)
- Habitat preference: salinity, depth, structures or substrata at different stages
- Other: Invasive sp.? Non-native sp.?

(3) Synecology (how this species fits into the greater ecology)

- Trophic interactions
 - What does it eat in different stages or seasons or habitats.
 - What eats it in different stages or seasons or habitats.
 - What are it's trophic competitors
- Non-trophic interactions with other species
- Processes thought to control the population size (e.g., bottom-up, top-down, density-dependence, etc.)

(4) Human Exploitation

- History of commercial landings
- History of recreational landings
- Fishery management plans
- Fishing regulations and limits

(5) References

- List the most important references that describe life history
- Use primary citations for data that you used.

2.2.5 Aquatic Resources

Topic 1: The Aquatic Ecoregion Surrounding the Power Plant

Describe the ecoregion surrounding the plant site in terms of

- the geomorphic, or physiographic, province - coastal plain, piedmont, etc. (because coastal plain streams differ from piedmont streams)
- the ecological province of the ocean if the plant affects an ocean or estuary
 - the watershed(s) and name and location of source and receiving water bodies for cooling system
 - local physiographic habitats, including onsite streams, swamps, marshes, etc. FWS National Wetland Inventory information should be presented in terms for lay reader.
- significant water bodies that intercept or parallel transmission lines

Topic 2: Physical Features of Affected Water Bodies

Describe location of site with respect to the principal nearby water body(ies) that it affects. Give location in river miles if appropriate. Describe location of main channel, dams, flood control. Describe additional uses of the water body other than cooling water.

Describe the source and receiving water bodies in some detail in terms of

- relationship to the watershed
- size
- shoreline, bathymetry
- tidal and net flows, including seasonal or occasional variations
- bottom types (sand, silt, clay, sandy silt, silty sand, etc.)
- water quality

Topic 3: History and Projected Future of the Affected Water Bodies

Major changes or modifications to the water bodies over the projected life of the plant. Typical things to describe include channelization, navigation, pollution, habitat degradation, urbanization, and development. Include pollution control or other programs designed for environmental improvement.

Topic 4: Potentially Affected Fish Community

Describe fish community briefly (consult licensee ER and any past studies, state and federal sources, local researchers, wildlife agencies, dissertations and theses at nearby colleges). Identify on “important” species culturally or ecologically, where “important” is defined in terms of the following characteristics:

- Potential or reported susceptibility to impingement and entrainment
- Dominance, commonness, or rarity in numbers or biomass
 - Importance to the structure and function of the ecosystem (e.g., keystone species, important trophic links, potential for trophic cascade, habitat formers or modifiers)
- Indication of water quality or “ecosystem health”
- Importance for recreational or commercial fishing.
- Introduced or non-native species
- Federally and state listed species (list)

Try to tie this list to species used for assessing impingement and entrainment effects.

Topic 5: Other Potentially Affected Aquatic Resource Communities

Discuss important invertebrates and plants (e.g., submerged aquatic vegetation [SAV], rooted aquatics, phytoplankton). Use guidelines above for fish to define “important.” Consider life stages that are susceptible to power plant effects.

Topic 6: Trends and Status of Aquatic Resources

Present trends in both fish and nonfish populations through time - focus on “important” species identified above. Check NMFS’s commercial and recreational catch databases and plot trends. Check for state fishery statistics.

Discuss status in terms of indicator communities for “ecosystem health” - Include any information on EPA Rapid Bioassessments done for state or local monitoring programs, EISs, RCRA, or CERCLA programs. Trends in SAV. Check EPA’s EMAP in estuaries and coastal regions and the USGS’s Biomonitoring of Environmental Status and Trends (BEST) Program. Check for state Fish Consumption Advisories and U.S. FWS’s Environmental Contaminants Program for environmental contamination and bioaccumulation. Check for state and regional Total Minimum Daily Load (TMDL) programs for protection of fish, shellfish, and wildlife.

Describe fishery management programs in power plant cooling lakes and reservoirs or affected water bodies.

Topic 7: Protected Aquatic Species

Introduce protected aquatic species:

“Aquatic species that are listed by the US FWS and/or NMFS, the State of _____, or the State of ___ and have the potential to occur in the vicinity of the _____ site or along the transmission corridors are presented in Table 2-?.”

The table lists the protected species that might be found in the counties that contain the site and transmission corridors under review.

Have a short paragraph on each protected species that may occur on the site or be affected by the plant. Comment on who has listed the species, their distribution, unique habitat requirements, reason(s) for listing, and any other information that might be relevant with respect to the determination that the species may be present or affected. If the species is known from the site or transmission corridors, provide additional information on number, spatial and temporal distribution etc. Discuss federally protected species first, then discuss state-protected species.

Discuss essential fish habitat and EFH species, if applicable.

2.2.6 Terrestrial Resources

Topic 1: The Terrestrial Ecoregion Surrounding the Power Plant

Describe the ecoregion and the geomorphic, or physiographic, province. Describe climax vegetation in which the site occurs. Give the USDA Plant Hardiness Zone.

Topic 2: Physical Features of Local and Potentially Affected Terrestrial Environment

Describe in general the local terrestrial environment of the site. Include soil types. Include topo maps or topographic descriptions. Refer to Aquatic Resources Topic 2 rather than repeat information.

Topic 3: History and Projected Future of Local and Potentially Affected Terrestrial Environment

Provide a short description of the terrestrial environment before European settlement. Briefly describe the transition of the terrestrial environment on the site from before plant construction to the present. Coordinate with Cultural Resources author on past ecology and man's influence.

Describe the vegetational succession stages on the site and the climax community that would/does occur, any agricultural lands, and other land cover. Future--Would vegetation stay in present successional stages or progress if license extension is granted or not?

Describe major wildlife living around site in the past and which species remain today.

Topic 4: Potentially Affected Plant Communities

The importance of plants in terrestrial environments is due not only to photosynthesis, which forms the basis of terrestrial food webs, but in forming and altering habitat for other natural communities.

List vegetational associations /communities and their common plant species (5 to 20), indicate their prevalence, habitat preference, and spatial extent, if known. See Example Table 2.2.X. Describe any invasive or noxious plant species prevalent on the site. Indicate the presence or absence of State or Federally regulated wetlands on site. Describe riparian plant communities along watercourses and plants in wetland areas.

Topic 5: Other Potentially Affected Terrestrial Communities

Describe wildlife species that occur at the site. List about ten to twenty of the most important terrestrial species - a few mammals, a few birds, a few reptiles, a few amphibians. Check with the State wildlife people. Mention any insects or invertebrates that may be important. Use definition of important from Aquatic Resources Topic 4. Comment on any onsite wildlife management activities with which the licensee might be involved.

Topic 6: Trends and Status of Terrestrial Resources

Present trends in both plant and animal populations or communities through time - focus on "important" species identified above. This may include land use—refer to cultural resources section.

To determine the "health of the ecosystem" in relation to contaminants in the area check EPA's Enviromapper website (also check this in regards to cumulative effects). Also check the USGS's Contaminant Exposure and Effects - Terrestrial Vertebrates (CEE-TV) Database.

For information on invasive species check the U.S. Department of Agriculture's National Invasive Species Information Center on their National Agriculture Library website.

Topic 7: Potentially Affected Terrestrial Communities in Transmission Right-of-Ways

To determine whether particular transmission line right-of-ways are within scope for the SEIS, refer to the rationalization presented in the letter from Cynthia Carpenter, NRC to William McCollum, Jr., Duke Energy Corporation dated 10 May, 1999 (file "ML0707905672 (Oconee letter).pdf", attached).

Describe in general the terrestrial environment of the transmission line right-of-ways. Discussion should be less detailed than for site although comprehensive. List and comment on each transmission line including the use of the land, successional state of the property, any agricultural use, and any other land cover. List major stream/river crossings, any significant wetland areas, any crossing of wildlife refuges, parkland, or any other significant conservation areas. Investigate and describe any cost sharing programs with the State or licensee for habitat conservation, or wildlife enhancement.

Topic 8: Protected Terrestrial Species

Introduction to protected terrestrial species.

"Terrestrial species that are listed by the US FWS and/or NMFS, the State of _____, or the State of ___ and have the potential to occur in the vicinity of the _____ site or along the transmission corridors are presented in Table 2-?."

The table, or tables (if you have a large number of species it might be best to break into two tables, one for Federal listed species and one for State listed species) list the protected species that might be found in the counties that contain the site and transmission corridors under review.

Have a short paragraph on each protected species. Comment on who has listed the species, species distribution, unique habitat requirements, reason for listing and any other information that might be relevant with respect to the determination that the species may be present and impacted. If the species is known from the site or transmission corridors provide additional information on number, spatial and temporal distribution etc. Discuss Federally protected species first, then discuss State-protected species. If the State list is numerous (>10 to 15) the

reviewer can choose to just include the species in a table and not discuss the species in the text unless there is some extraordinary reason.

**EXAMPLE TABLE FOR DESCRIBING VEGETATIONAL ASSOCIATIONS / COMMUNITIES AROUND FACILITY
(LOOSELY TAKEN FROM BEAVER VALLEY STATION LICENSE RENEWAL ENVIRONMENTAL REPORT)**

Table 2.X. Vegetational associations^a in the area surrounding XYZ power plant, CCC County, SSS State.

Description	Typical Vegetation and Location	Associated Fish and Wildlife Services
Early Old Field	Coverage of 90 percent or more by herbaceous species, including a variety of grasses, forbs, creepers, climbers, parasites and composites, often forming thickets. X ha of this type of community occur at ...	Relatively high food, cover, nesting, and resting value for birds and wildlife. Mammals in these areas typically include meadow vole (<i>Mycrotus pennsylvanicus</i>), short-tailed shrew (<i>Blarina brevicauda</i>), white-tailed deer (<i>Oedocoileus virginiana</i>), woodchuck (<i>Marmota monax</i>), cottontail rabbit (<i>Sylvilagus floridanus</i>), beaver (<i>Castor canadensis</i>), and muskrat (<i>Ondatra zibethicus</i>).
Mature bottomland Hardwood
Palustrine emergent	Characterized by erect, rooted, herbaceous halophytes, at least remnants of which are generally persistent throughout the year, including sensitive fern (<i>Onoclea sensibilis</i>), broad-leafed cattail (<i>Typha latifolia</i>), duck potato (<i>Sagittaria latifolia</i>), sedges (<i>Cyperus</i> spp., <i>Carex</i> spp.), spike rushes (<i>Eleocharis</i> spp.), smartweeds, and others. This area occurs intermittently along the south bank of RR River about XX km south of the plant.	Provides feeding and resting habitat for migratory shore and wading birds such as ... Typical reptiles and amphibians include ... Mammals using this habitat include ...
...

^aIf all information from one source, add as a footnote here. If many sources used, create a separate column entitled "Source" on right.

4.1.1 Entrainment

Topic 1: Introduce Entrainment Concepts

State that entrainment is a site-specific issue requiring a site-specific assessment before license renewal (Category 2). State which documents and other sources of information were reviewed.

Entrainment is the taking in of organisms with the cooling water. The organisms involved are generally of small size, dependent on the screen mesh size, and include phyto- and zooplankton, fish eggs and larvae, shellfish larvae, and many other forms of aquatic life. (U.S. EPA 1977).

U.S. EPA. 1977. Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment: Section 316(b) P.L. 92-500. Draft May 1, 1977. Office of Water Enforcement, Permits Division, Washington, D.C.

Requirements under 316(b) of Clean Water Act--use this paragraph:

Section 316(b) of the Clean Water Act (CWA) requires that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment of fish and shellfish into the cooling water system is a potential adverse environmental impact that can be minimized by use of the best available technology.

Topic 2: Describe and Summarize Entrainment 316(b) Studies

Name of study

Stated purpose

Methods

Duration of sampling - beginning and end of studies

Frequency of sampling

Locations sampled and gear used

Randomization, sample size, replication

Analytical/statistical methods to estimate adverse effects from entrainment sampling data

Results

NRC evaluation of the study with respect to providing information for our assessing impact.

Focus on most vulnerable and important (refer to Section 2.2.5. Aquatic Resources) 5 to 10 species

Describe seasonal patterns of abundance on entrainable life stages and species

Focus on results that provide insight into impact, e.g., annual losses or mortality rates by species

Topic 3: Summarize Any Other Studies That Provide Insight into Entrainment Impact

Scour literature for any other entrainment studies on same body of water by applicant or others. Relate findings of these studies to the applicant's 316(b) demonstration. Focus on abundance and spatial and temporal distribution of "important" species (Section 2.2.5). Discuss any significant departure from the data collected or conclusions reached during the 316(b) demonstration.

Topic 4: Provide Perspective on Entrainment Losses

Numbers entrained alone do not convey impact. Possibilities for perspective include (1) comparison of conditional entrainment mortality rates to natural mortality rates, (2) projections of losses at some age to fishery losses projected to the same age, (3) other simulation model results, (4) analysis of empirical trends.

Where no other perspective is available, contrast flow through plant to flow by the plant. Provide a percentage. Calculate percentage of flow entrained for periods during presence of "important" species. NB: Because of behavior and other factors, past studies have shown that the percent of ichthyoplankton populations withdrawn from a water flowing past a plant differs from the percent of water withdrawn, and this difference is a source of uncertainty.

Entrainment survival can generally be assumed to be zero percent (U.S. EPA 2004, NUREG 1555).

US EPA. 2004. Regional Analysis Document for the Final Section 316(b) Phase II Existing Facilities Rule. EPA-821-R-02-003. February 13, 2004. Office of Water, Washington, D.C.

Topic 5: Assign Impact Rating for Entrainment

Summarize findings of licensee. Summarize findings of 316(b) demonstration. Summarize NRC staff findings from above. Assign rating of SMALL, MODERATE or LARGE impact and provide rationalization for that rating. Note that the impact of cooling water system operation includes impingement, entrainment and heat shock and that entrainment is separated out here for convenience.

Topic 6: Discuss Mitigation

Present possible mitigation measures and whether they would be beneficial at this site.

4.1.2 Impingement

Topic 1: Introduce Impingement

State that impingement is a Category 2 issue requiring a site-specific assessment before license renewal. State what documents or sources of information were reviewed.

Impingement is the entrapment of organisms against the cooling water intake screens. A particular life stage of a species can be subject to both entrainment and impingement if some individuals are caught on screens and others pass through.

Requirements under 316(b) of the clean water act--use this paragraph:

Section 316(b) of the Clean Water Act (CWA) requires the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Impingement of fish and shellfish on the debris screens of the cooling water intake system is a potential adverse environmental impact that can be minimized by use of the best available technology.

Topic 2: Describe and Summarize Impingement 316(b) Studies

Impingement studies for 316(b) demonstrations are performed to estimate number of particular species and life stages impinged, their survival rates, or to answer other site-specific questions.

Name of study

Stated purpose

Methods

Duration of sampling - beginning and end of studies

Frequency of sampling

Locations sampled and gear used

Randomization, sample size, replication

Analytical/statistical methods to estimate adverse effects from entrainment sampling data

Results

Focus on most vulnerable and important (refer to Section 2.2.5. Aquatic Resources) 5 to 10 species

Describe seasonal patterns of abundance on entrainable life stages and species

Focus on results that provide insight into impact, e.g., annual losses or mortality rates by species

NRC evaluation of the study with respect to providing information for our assessing impact.

Topic 3: Summarize Any Other Studies That Provide Insight into impingement Impact

Scour literature for any other entrainment studies on same body of water by applicant or others. Relate findings of these studies to the applicant's 316(b) demonstration. Focus on abundance and spatial and temporal distribution of "important" species (Section 2.2.5). Discuss any significant departure from the data collected or conclusions reached during the 316(b) demonstration.

Topic 4: Provide Perspective on Impingement Losses

Numbers impinged alone do not convey impact. Possibilities for perspective include (1) comparison of conditional entrainment mortality rates to natural mortality rates, (2) projections of losses at some age to commercial and recreational fishery losses projected to the same age, (3) other simulation model results, and (4) empirical trend analysis.

In performing trend analysis for fisheries, check resource agencies. Find out either quantitatively or qualitatively how the fishery has been performing since the plant began operation. If the plant was having a significant effect, the fishery should be declining. If the plant is not having a significant effect, then the fishery should be relatively stable or improving. Certain species may be in decline, but if they are "important" there probably is an explanation in the literature. Focus on "important" species; you probably will only have data on these anyway. If you choose this approach be sure to investigate and evaluate any programs that are supplementing the populations of "important" species (e.g. massive stocking programs). Also consider any obvious natural or man induced impacts that may be affecting the populations (e.g. recovery of an ecosystem due to improvement in water quality whether due to importation of exotic species or cessation of manmade pollution).

Topic 5: Assign Impact Rating for Entrainment

Summarize findings of licensee. Summarize findings of 316(b) demonstration. Summarize NRC staff findings from above. Assign rating of SMALL, MODERATE or LARGE impact and provide rationalization for that rating. Note that the impact of cooling water system operation includes impingement, entrainment and heat shock and that entrainment is separated out here for convenience.

Topic 6: Discuss Mitigation

Present possible mitigation measures and whether they would be beneficial at this site.

4.1.3 Heat Shock

Topic 1: Introduction to Heat Shock

Note that the GEIS does not specifically address or even define “heat shock.” We can address this omission in the GEIS update. The following is largely unchanged from Mike’s previous draft.

Focus on heat shock and not thermal effects in general. A number of Category 1 issues address the chronic effects of elevated temperatures, but heat shock is the acute effect of heated water on aquatic organisms resulting in almost immediate distress or mortality. The station’s 316(a) demonstration that should address a broad range of thermal affects has to be discussed. The following text may help:

For plants with once-through cooling systems and cooling pond heat dissipation systems, NRC (1996) lists the effects of heat shock an issue requiring plant-specific evaluation before license renewal (Category 2). The NRC (1996) listed impacts on fish and shellfish resources resulting from heat shock as a site-specific issue because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions.

Information considered includes the type of cooling system (whether once-through or cooling pond), evidence of a CWA Section 316(a) variance or equivalent State documentation, and other information. To perform this evaluation, NRC staff reviewed the [plant name] ER (citation); visited the [plant name] site; reviewed the facility’s 316(a) demonstration dated [date issued] and submitted to the [name of permitting agency]; and reviewed the applicant’s State of [State name] NPDES Permit No. [NPDES permit number], issued on [issue date], and in force until [expiration date] (Citation).

Topic 2: Describe the Cooling Water System and Permit Limitations

In one sentence, describe the type of cooling system at the facility and refer to Section 2.1.3 (Cooling and Auxiliary Water Systems) for more detail.

Describe the licensee’s 316(a) demonstration, when submitted, when approved. Summarize findings of the demonstration and any conclusions made by the permitting agency.

Describe current thermal limitations on licensee as given in the current NPDES permit (include such details as flow limits, ΔT , areal extent of mixing zone, distance downstream that the mixing zone extends, temperature limits at the edge of the mixing zone). Describe any operational limits on the facility due to the thermal discharge. Describe these limits and any other facility modifications and how these limits or changes reduce potential thermal impacts. Discuss how the limits or changes mitigate the possible need to further modify thermal discharges in response

to possible changes in environmental conditions. Describe the compliance history of the facility relative to meeting the thermal limitations in the NPDES permit.

Research any heat shock incidents at the site. Heat shock incidents are incidences of elevated receiving water temperatures during station operation resulting in the immediate distress or acute mortality of fish. Incidents should be described in detail and any measures taken to prevent recurrence discussed.

Topic 3. Assign Impact Rating for Heat Shock.

Analysis of impact. Contrast the area of the mixing zone with the receiving water body. Comment on the impact of any past heat shock events that may have occurred at the site.

Mention that heat shock to fish is a function of the temperature increase that the fish are subjected to in the receiving waters and the residence time of the fish in the elevated temperatures of the discharge flow (Fry 1971; Dean 1973). See also Beitinger et al 2000. Focus on acute not chronic effects.

If appropriate talk about upper lethal threshold temperatures for representative or “important species and residence time in areas with elevated temperatures. Can organisms escape the elevated temperatures (thermal blockage)? Remember we are not talking about the thermal blockage that could prevent migration of anadromous or catadromous fishes past the site. Instead the rather rare situation in which there is a thermal blockage of individuals due to the unique characteristics of the site and resulting in organisms trapped in an area of gradually increasing temperatures with no route of escape except through the plume.

End with:

The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, the State [name of State], the 316(a) demonstration, and other public sources. The staff evaluated the potential impacts to aquatic resources due to heat shock during continued operation. It is the staff's [preliminary] conclusion that the potential impacts to fish and shellfish due to heat shock during the renewal term are [SMALL, MODERATE, LARGE].

Assign rating of SMALL, MODERATE or LARGE impact and provide rationalization for that rating.

[If the impact assessment is MODERATE, discuss the how potential environmental effects are sufficient to alter noticeably the aquatic organisms at the plant, but not to destabilize, important attributes of the resource.]

[If the impact assessment is LARGE, discuss the how potential environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the aquatic organisms at the plant.]

During the course of the [Draft] SEIS preparation, the staff considered mitigation measures for the continued operation of [plant name] during the license renewal period. Based on the [assessment to date] [staff's assessment] measures in place at [plant name] (e.g., design and placement of the discharge) [provide] [do not provide] mitigation of impacts related to heat shock, and [no new mitigation measures are warranted] [additional mitigation is warranted].

Un-numbered. Effects of the Cooling Water System

The effects of the cooling water system include the effects of impingement, entrainment and the thermal discharge. If you look at trends in numbers of a species in the wild that susceptible to subject to any two or all three, you might not be able to parse the sources. We presently have no section where such a total effect of the cooling water system is addressed, although we hope to correct that situation. For right now, put the effects under the most likely or largest of the sources and include the other sources of impact.