Chapter 6: Facility Compliance Costs

INTRODUCTION

This chapter presents the estimated costs to facilities of complying with the proposed §316(b) New Facility Rule. EPA developed costs at three levels: (1) unit costs of complying with the various requirements of this regulation, including costs of §316(b) technologies and administrative costs; (2) facility-level costs for each projected in scope facility; and (3) total facility compliance costs aggregated to the national level. This chapter also presents cost estimates for eight additional case study facilities. The last section of this chapter discusses uncertainties and limitations in EPA's compliance cost estimates.

CHAPTER CONTENTS

6.1 Unit Costs 6-2
6.1.1 §316(b) Technology Costs 6-2
6.1.2 Administrative Costs 6-9
6.2 Facility-Level Costs 6-12
6.2.1 New Electric Generators 6-13
6.2.2 New Manufacturing Facilities 6-16
6.3 Total Facility Compliance Costs 6-19
6.4 Case Study Facility Costs 6-21
6.5 Limitations and Uncertainties 6-23
References 6-25

Facilities generally have several alternatives for complying with the proposed rule's requirements.[1] Alternative compliance responses include:

- ***Compliance Response 1: Change the cooling system design so the facility would no longer be subject to regulation under the proposed §316(b) New Facility Rule:*** A facility may choose to use an alternative (a water other than those of the U.S.) cooling source, e.g., gray water or dry cooling, or to redesign its cooling water system to withdraw less than two million gallons per day (MGD). Under both scenarios, a facility would no longer be in scope of this regulation but might incur costs associated with these design changes.

- ***Compliance Response 2: Change the source water body type and make alterations to meet requirements based on the new water body type and the distance from the littoral zone:*** A facility may choose to locate on a different type of water body to reduce the stringency of its compliance requirements (e.g., locate on a lake or river instead of an estuary). This alternative may involve costs of redesigning the facility or acquiring land near the substitute water body as well as the cost of any requirements associated with the new water body type and distance from the littoral zone.

- ***Compliance Response 3: Change the distance from the littoral zone and make alterations to meet requirements based on water body type and the new distance from the littoral zone:*** A facility may choose to relocate the entrance of its intake structure within the water body to reduce the stringency of its compliance requirements (i.e., locate the intake outside of the littoral zone or more than 50 meters away from the littoral zone). This alternative may involve additional capital costs to extend the facility's intake pipe or to dredge an intake canal to make the intake deeper, as well as the cost of any requirements based on the new distance from the littoral zone.

- ***Compliance Response 4: Make alterations to meet requirements based on the baseline water body type and distance from littoral zone:*** A facility may choose to retain its planned location (water body type and distance from the littoral zone) and implement all measures required by the regulation. This alternative may involve costs of widening the intake structure or installing a velocity cap or passive screens to reduce velocity; and switching to a recirculating system to reduce intake flow;

[1] Compliance requirements vary with water body type and distance from the water body's littoral zone. See *Chapter 1: Introduction and Overview* for a summary of this rule's requirements.

implementing additional technologies to reduce impingement and entrainment (I&E).

The remainder of this chapter presents the estimated costs of compliance and the methodology and unit costs used to develop the estimates. The chapter is organized as follows:

- Section 6.1 presents the unit costs associated with various compliance actions that facilities may take as part of the compliance alternatives described above. The unit costs include average costs of implementing specific changes to a facility's cooling water intake structure (CWIS) or its cooling water system and are based on certain facility characteristics such as volume of flow. Unit costs are also estimated for administrative activities.

- Section 6.2 discusses the development of compliance cost estimates for the 98 projected new in scope facilities and presents the estimated costs.

- Section 6.3 presents the estimated facility compliance costs aggregated to the national level.

- Section 6.4 presents an estimate of facility costs for eight additional case study facilities.

- The final Section 6.5 discusses the limitations and uncertainties in EPA's compliance cost estimates.

6.1 UNIT COSTS

Unit costs are estimated costs of certain activities or actions, expressed on a uniform basis (i.e., using the same units), that a facility may take to comply with the regulatory requirements. Unit costs are developed to facilitate comparison of the costs of different actions. For this analysis, the unit basis is dollars per gallon per minute ($/gpm) of cooling water intake flow. All capital and operating and maintenance (O&M) costs were estimated in those units. These unit costs are the building blocks for developing costs at the facility and national levels. Individual facilities will incur only a subset of the unit costs, depending on the extent to which they would already comply with the requirements as originally designed (in the baseline) and on the compliance response they select. The unit costs presented in this section are engineering cost estimates, expressed in 1999 dollars. More detail on the development of these unit costs is provided in the appendices.

6.1.1 §316(b) Technology Costs

New facilities that in their original design do not comply with the §316(b) New Facility Rule framework would have to implement one or more technologies to reduce I&E. These technologies reduce I&E through one of four general methods:

- changing the location of the CWIS in a water body;
- reducing the design intake flow;
- reducing the design intake velocity; or
- implementing other design and construction technologies (referred to as other technologies) to reduce damage from I&E.

The remainder of Section 6.1.1 discusses specific §316(b) technologies and their respective costs.

a. Changing the Location of the CWIS in a Water Body

EPA analyzed two options for altering the location of a planned facility's CWIS: extending the intake pipe to increase the distance from the littoral zone, and deepening the intake canal to withdraw water from below the littoral zone.

❖ ***Extending the intake pipe***

There are a number of different methods for underwater pipe laying, including use of conventional pipe laying vessels, bottom-pulling, and micro-tunneling.[2] Each of these methods requires the use of skilled labor and specialized equipment and materials. The following general assumptions were used to estimate costs associated with extending an intake pipe:

- The littoral zone ends approximately 25 meters from the shoreline.[3] If a pipe extends 75 meters from the shoreline it would be 50 meters outside the littoral zone. The maximum necessary extension of the intake pipe to be at least 50 meters outside of the littoral zone therefore is 75 meters.

- The source water body is wide enough so that a pipe extending 75 meters from one shore/river bank will also be at least 75 meters from the opposite shore/bank. The intake structure would therefore meet the requirement of being at least 50 meters outside of the littoral zone on both sides of the source water body.

Table 6-1 presents a summary of the estimated costs associated with installing intake pipes of 25 meters and 125 meters in length using each method of installation. The table shows that for the pipe-laying vessel and bottom-pull

[2] See Appendix A for a more detailed discussion on the pipe extension technologies.

[3] The littoral zone may extend for more or less than 25 meters, depending on site-specific characteristics of the water body. The assumption of 25 meters is used for costing purposes only.

methods, the length of the pipe has a minimal impact on the total cost (the main cost components being the equipment and labor costs). The total cost associated with the micro-tunneling technique, on the other hand, does vary with the length of the pipeline. For micro-tunneling, to develop cost curves and equations based on flow, EPA assumed a pipe extension distance of 125 meters. Further details on the development of cost estimates are provided in Appendix A.

Table 6-1: Costs of Extending the Intake Pipe ($1999)

Method of Installation	Cost		Necessary Days to Complete Work		Total Cost	
	Rent Equipment / Labor	Pipe / Materials	25 meters	125 meters††	25 meters	125 meters††
Pipe Laying Vessel	$90,000 - $110,000 per day (all inclusive)	minimal	1	1	$90,000 - $110,000	$90,000 - $110,000
Bottom-Pull Method	$20,000 per day for a barge and labor	minimal	1	1	$25,200-$27,000	$25,200-$27,000
	$2,000 - $4,000 per day for a crane		1	1		
	$500 per day for welders		1	1		
	$1,350 per day for a bulldozer		2	2		
Micro-Tunneling	$1,000 - $2,000 per foot of piping (includes installation and material costs)		n/a	n/a	$82,000-$164,000	$410,000-$820,000

† See Appendix A for cost curves and further details on the development of cost estimates.

†† The costs presented in this table are based on extending the pipe for 125 meters rather than 75 meters. The cost for extending the pipe for only 75 meters may be as much as 30 to 40 percent lower, depending on the pipe extension method used. This potential decrease in costs would have minimal impact on the overall estimated cost of the proposed rule.

❖ ***Deepening the intake canal***

Shoreline intakes often have a dredged canal with a baffle or skimmer wall and withdraw water from below the surface. Deepening the canal such that the intake opening is below the littoral zone may require additional dredging.[4] For the smallest size canal, EPA assumed that an additional 10,000 cubic yards (CY) of sediments will be removed using a dredger.[5] For large size canals, EPA assumed that increasing the depth below the littoral zone entails the dredging of an area of 10 by 40 by 100 yards. Widening, dredging, and dumping operations are assumed to be accomplished using a 2,000 gallons per CY dredger at a cost of $12.25 per CY. Based on these estimates, the costs associated with deepening an intake canal to comply with the proposed §316(b) New Facility Rule range between $122,500 for a small canal to $490,000 for a large canal. A cost curve is included in Appendix A.

These costs apply to situations where sediments are disposed of onsite with no preparation costs. If sediments are contaminated, the permitting authority may require transport to and disposal at an offsite facility, which may double or triple the operational costs and may also delay construction of the new facility.

b. Reducing Design Intake Flow

New facilities that do not comply with the flow criteria established by the proposed §316(b) regulatory framework have a number of alternatives for reducing their intake flow to meet the rule's requirements. EPA analyzed two options for reducing the design intake flow and developed cost estimates for these two options: switching to a recirculating system and using a water other than those of the U.S.

By switching to a recirculating system or using an alternative cooling water source, it is possible for a new facility to reduce its intake flow to less than two MGD and

[4] The same assumptions were made here for the dimension of the littoral zone as in the section on extending the intake pipe.

[5] This estimate assumes that the canal dimensions are 10 by 100 yards and the canal will be deepened by an additional 10 yards.

therefore be exempt from the proposed §316(b) New Facility Rule. For some facilities, the cost of reducing the intake flow such that they are exempt from regulation under §316(b) may be lower than that of any other compliance response.

❖ *Switching to a recirculating system*

Switching to a recirculating system involves redesigning the proposed facility to replace the planned once-through cooling system. Cooling towers are by far the most common type of recirculating system. EPA therefore assumed that all planned facilities switching to recirculating systems will use cooling towers.

Cooling tower configurations differ with respect to design characteristics such as the type of air flow (either natural or mechanical draft), the materials used in tower construction (wood, fiberglass, steel, and/or concrete), and whether water is recirculated or discharged to a receiving water body after cooling (only configurations that involve recirculating will be useful in meeting the regulatory requirements). The cost of installing cooling towers and their associated intakes and equipment is largely determined by the volume of cooling water needed, the material used to construct the tower (e.g., redwood, steel), and the special features of the tower (e.g., plume abatement). The volume of water needed for cooling depends on the following factors: source water temperature and quality; the type of cooling tower installed (i.e., whether it is natural or mechanical draft); type and make of equipment to be cooled (e.g., coal fired equipment, natural gas powered equipment); and the plant size/generating capacity (e.g., 50 megawatt vs. 200 megawatt).

Table 6-2 presents estimated capital and installation costs for different types of basic cooling towers and associated equipment, broken down by the volume of water used. Based on conversations with industry experts, installation costs are assumed to be 80 percent of the cooling tower equipment cost. The costs presented in Table 6-2 are the installation costs for a "basic" cooling tower (i.e., standard fill without special features) and associated equipment. For costing purposes, EPA assumed that a red-wood, splash-filled cooling tower would be installed because this type of tower has typical average costs. Site-specific conditions may require the installation of additional equipment to mitigate environmental impacts, such as drift, plume, and noise controls, at additional cost.

Table 6-2: Capital and Installation Costs for Cooling Towers ($1999)

Flow (gpm)	Douglas Fir Cooling Tower	Redwood Tower	Concrete Tower	Steel Tower	Fiberglass-Reinforced Plastic Tower
2,000-18,000	$108,000-$972,000	$121,000-$1,089,000	$151,000-$1,361,000	$146,000-$1,312,000	$157,000-$1,409,000
22,000-36,000	$1,148,400-$1,879,200	$1,286,000-$2,105,000	$1,608,000-$2,631,000	$1,550,000-$2,537,000	$1,665,000-$2,725,000
45,000-67,000	$2,268,000-$3,3768,00	$2,540,000-$3,782,000	$3,175,000-$4,728,000	$3,062,000-$4,559,000	$3,289,000-$4,896,000
73,000-102,000	$3,679,200-$4,957,200	$4,121,000-$5,552,000	$5,151,000-$6,940,000	$4,967,000-$6,692,000	$5,335,000-$7,188,000
112,000- 204,000	$5,443,200-$9,180,000	$6,096,000-$10,282,000	$7,620,000-$12,852,000	$7,348,000-$12,393,000	$7,893,000-$13,311,000

† See Appendix A for cost curves and further details on the development of cost estimates.

EPA also estimated O&M costs for cooling towers. These O&M costs tend to be driven by factors such as:

- the size of the cooling tower,
- the material from which the cooling tower is built,
- various features of the cooling tower,
- the source of make-up water,
- the disposition of blowdown water, and
- the tower's remaining useful life (maintenance costs increase as useful life diminishes).

To calculate estimated annual O&M costs, EPA made the following assumptions:

- For small cooling towers, five percent of capital costs is attributed to chemical costs and routine maintenance. To account for economies of scale, that percentage is gradually decreased to two percent for the largest cooling tower. This assumption is based on discussion with industry representatives.

- Two percent of tower flow is lost to evaporation and/or blowdown and/or drift, based on discussions with industry representatives.

- Make-up water was assumed to come from a water of the U.S., and disposal of blowdown was assumed to be to either a pond or back to the original water source, at a combined cost of $0.50/1000 gallons.

- Maintenance costs are 15 percent of capital costs, averaged over a 20 year period, based on discussions with industry representatives.

Cost curves developed based on the above assumptions and used to estimate costs are included in Appendix A, along with further details on the development of estimated costs.

❖ *Using a water other than those of the U.S.*

The use of a recirculating cooling water system does not eliminate the need for a supply of water. Facilities using cooling towers need a supply of cooling water to "make-up" for the water that is lost from the cooling process because of evaporation, blow down, and drift. This make-up water can come from a water of the U.S., ground water, a municipal domestic water supply, or the treated wastewater that is discharged from municipal wastewater treatment plants (gray water). Data from various existing utility databases, the §316(b) Screener Questionnaire, and the NEWGen database indicate a trend toward increased use of cooling towers and waters other than those of the U.S. for make-up water for power generation units coming on-line in recent years or planned to come on-line in the near future. Make-up water obtained from a domestic water supply or treated wastewater must be purchased.

EPA contacted several water and wastewater treatment plants in the Washington, DC area to develop cost estimates for using gray water as cooling tower make-up water. Cost data from power plant siting applications submitted to siting boards by utilities were also obtained. The cost for gray water varies greatly from one geographic area to another based on the availability of alternative sources of cooling water. Rate schedules for gray water supply are typically set such that costs per gallon increase with consumption. A review of cost estimates from wastewater treatment plants and siting applications indicates that the cost of gray water ranges from approximately $1.5 to $3 per 1,000 gallons for a facility with daily flows typical of electric generating facilities with recirculating cooling towers. Based on this review, EPA estimated a unit cost of $3/1000 gallons for the purchase of make-up gray water from a wastewater treatment plant. These costs do not include treatment or discharge costs. However, if on-site treatment is necessary, EPA estimates that the cost would be approximately $0.5/1000 gallons.

EPA also contacted the Washington Suburban Sanitary Commission to gather cost estimates for municipal domestic water for use as cooling water. A facility using municipal sources for clean make-up water and disposing of the blow down water into a publicly-owned treatment works (POTW) sewer line would incur a combined cost of $4/1000 gallons.

c. Reducing Design Intake Velocity

A facility not in compliance with the velocity criteria established by the proposed §316(b) regulatory framework may need to alter its CWIS to reduce the design intake velocity. This reduction can be achieved by branching the intake into a greater number of openings/pipes, installing velocity caps, or constructing a passive screen system. Each of these options is discussed below.

❖ *Passive screens*

Passive intake systems are those devices which screen-out debris and biota with little or no mechanical activity required. Most of these systems are based on the principle of achieving very low withdrawal velocities at the screening media. Passive screens reduce velocity by exploiting hydrodynamics. Hydrodynamic exclusion results from maintenance of a low through-slot velocity which allows organisms to escape the flow field. The physical shape and dimension (width and depth) of passive screens are determined by the application and site-specific conditions. See Appendix A for a more detailed description of the screen technologies.

Estimated capital costs for passive screens are shown in Table 6-3. These costs are based on discussions with industry representatives. The table presents costs for basic passive screens, made of carbon steel with a coating of epoxy paint. Passive screens larger than those presented in Table 6-3 will correspond to flows greater than 50,000 gallons per minute (gpm). Intake structures with flows in excess of 50,000 gpm are typically very large and the network fanning required for the total number of intake points and screens generally make passive screen systems infeasible.

Table 6-3: Capital Costs for Passive Screens - Stainless Steel ($1999)

Well Depth (ft)[††]	Screen Panel Width (ft)[†††]			
	2	5	10	14
10	$34,200	$56,100	$91,800	$128,700
25	$49,800	$84,900	$140,400	N/A
50	$74,400	$122,700	N/A	N/A
75	$99,000	N/A	N/A	N/A
100	$135,600	N/A	N/A	N/A

[†] See Appendix A for cost curves and further details on cost estimate development.
[††] Well depth includes the height of the structure above the water line.
[†††] N/A indicates that costs were not estimated because passive screen systems of this size are not feasible.

Generally, there are no appreciable O&M costs for passive screens. In situations with biofouling problems or zebra mussels in the environment, special materials for the screens and periodic mechanical cleaning may be needed. Air backwash systems require periodic maintenance. These costs, however, are minimal.

❖ ***Velocity caps***

A velocity cap is used on vertical intakes located offshore. The velocity cap is a cover placed over the intake which converts vertical flow into horizontal flow at the entrance into the intake. The device works on the premise that fish will avoid rapid changes in horizontal flow. These devices have shown good performance for the protection of aquatic organisms. The primary cost driver for velocity caps is the installation costs. Installation is carried out underwater where the water intake mouth is modified to fit the velocity cap over the intake. Costs for installing velocity caps were estimated based on the following assumptions:

- Four velocity caps can be installed per day.
- Cost of the installation crew is similar to the cost of water screen installation crews (see Appendix A).
- To account for the difficulty of deep water installations, an additional work day is assumed for every increase in depth category.
- Equipment cost for a velocity cap is assumed to be 25 percent of the velocity cap installation cost.

Table 6-4 presents the estimated capital and installation costs for installing velocity caps at various depths. The number of velocity caps needed for various flow sizes is estimated based on a flow velocity of 0.5 ft/sec and assumes that the intake area to be covered by the velocity cap is 20 square feet.

Table 6-4: Capital and Installation Costs for Velocity Caps ($1999)

Flow (gpm) (No. of velocity caps)	Water Depth (feet)				
	8	20	30	50	65
Up to 18,000 (4 VC)	$10,000	$15,625	$21,250	$26,875	$32,500
18,000 < flow < 35,000 (9 VC)	$15,625	$21,250	$26,875	$32,500	$38,125
35,000 < flow < 70,000 (15 VC)	$26,875	$32,500	$38,125	$43,750	$49,375
70,000 < flow < 100,000 (23 VC)	$38,125	$43,750	$49,375	$55,000	$60,625
157,000 (35 VC)	$55,000	$60,625	$66,250	$71,875	$77,500
204,000 (46 VC)	$71,875	$77,500	$83,125	$88,750	$94,375

† See Appendix A for cost curves and further details on cost estimate development.

❖ ***Branching the intake pipe to increase the number of openings or widening the intake pipe***

Facilities can reduce the intake velocity to meet the requirements of the proposed §316(b) New Facility Rule by branching their intake pipe using a Tee to withdraw water from a greater number of openings or widening the pipe opening using an enlarger. For costing purposes, EPA assumed that the intake pipes were originally designed to withdraw water at a 3 ft/sec velocity (a reasonable low velocity at which silt will not settle in the pipe) and that a Tee or an enlarger will be fitted at the pipe opening to achieve the desired 0.5 ft/sec velocity. The cost of fittings for branching an intake pipe to reduce intake flow velocity is assumed to be 15 percent of pipe capital cost.[6] These estimated costs are given by the cost curves in Appendix A.

d. Implementing Other Design and Construction Technologies to Reduce Damage from I&E

Facilities may also have to employ additional technologies that reduce the extent of I&E, depending on their CWIS location and velocity. EPA considered adding traveling screens with fish baskets or adding fish baskets to existing screens, as ways to limit I&E.

❖ ***Installation of traveling screens with fish baskets***

Vertical traveling screens contain a series of wire mesh screen panels that are mounted end to end on a band to form a vertical loop. As water flows through the panels, debris and fish that are larger than the screen openings are caught on the screen or at the base of each panel in a basket. As the screen rotates, each panel passes through a series of spray wash systems which remove debris and fish from the basket. The first system is a low pressure spray wash which is used to release fish to a bypass/return trough. Once the fish have been removed, a high pressure jet spray wash system is used to remove debris. As the screen continues to rotate, the clean panels move down and back into the water to screen intake flow.

Two components were analyzed in estimating total capital costs associated with the installation of traveling screens with fish baskets: equipment costs and installation costs. Equipment costs for a basic traveling screen with fish baskets include costs for screens constructed of carbon steel coated with epoxy paint, a spray system, a fish trough, housings and transitions, continuous operating features, a drive unit, frame seals, and engineering. Installation costs include costs for site preparation and earthwork, clearing the site, excavation, paving and surfacing, and structural concrete work and underwater installation (personnel, equipment, and mobilization, including their cost of a barge equipped with a crane and the crew to operate it.

Table 6-5 presents the total capital costs associated with the installation of traveling screens with fish baskets. Costs are presented for screen panels of various widths and for selected well depths. Well depth includes the height of the structure above the water line and can exceed water depth by a few to tens of feet. Costs are calculated based on vendor estimates and information from *Heavy Construction Cost Data 1998* (R.S. Means, 1997) and Paroby (1999).

O&M costs for traveling screens vary by type, size, and mode of operation of the screen. Based on discussions with industry representatives, EPA estimated that the annual O&M cost factor ranges between eight percent of total capital cost for the smallest traveling screen (with and without fish baskets) and five percent for the largest

[6] This cost estimate is based on best professional judgement and was verified with costs reported in R.S. Means (1997).

traveling screen since O&M costs do not increase proportionateley with screen size. See Appendix A for further information on O&M costs.

Table 6-5: Capital Costs for Traveling Screens with Fish Baskets ($1999)

Well Depth (ft)	Screening Basket Panel Width (ft)			
	2	5	10	14
10	$90,500	$132,000	$202,000	$285,000
25	$129,250	$194,000	$307,000	$453,000
50	$191,500	$287,000	$458,000	$647,000
75	$253,750	$381,500	$589,000	$831,000
100	$336,000	$477,000	$720,000	$1,010,000

† See Appendix A for cost curves and further detail on the development of cost curves.

❖ ***Adding fish baskets to existing traveling screens***
The costs associated with adding fish baskets to existing traveling screens were assumed to include equipment costs, installation costs, and costs associated with upgrading existing control systems from intermittent to continuous operation. Equipment costs include the cost of a spray system, a fish trough, housings and transitions, a drive unit, frame seals, and engineering. EPA assumed that installation costs would be 75 percent of the underwater portion of the installation costs of a traveling screen (based on best professional judgement). The use of a barge and crane would generally not be needed, and site preparation costs would be minimal.

Table 6-6 presents the total estimated capital costs for adding fish baskets to an existing traveling screen. Costs are presented for screen panels of various widths and for selected well depths. Costs are calculated based on vendor estimates from *Heavy Construction Cost Data 1998* (R.S. Means, 1997), Paroby (1999), and best professional judgement.

Table 6-6: Capital Costs for Adding Fish Baskets to Existing Traveling Screens ($1999)

Well Depth (ft)	Screening Basket Panel Width (ft)			
	2	5	10	14
10	$46,200	$55,575	$71,550	$100,725
25	$68,250	$79,125	$107,100	$154,275
50	$100,500	$121,875	$161,850	$239,025
75	$132,750	$161,625	$216,600	$323,775
100	$165,000	$201,375	$271,350	$408,525

† See Appendix A for cost curves and further detail on the development of cost curves.

The additional O&M costs incurred as a result of adding fish baskets to existing traveling screens were estimated by taking the difference between estimated O&M costs for traveling screens *with* fish handling features and the estimated O&M costs for traveling screens *without* fish handling features.

6.1.2 Administrative Costs

Compliance with the proposed §316(b) New Facility Rule requires facilities to carry out certain administrative functions. These are either one-time requirements (compilation of information for the initial NPDES permit) or recurring requirements (compilation of information for NPDES permit renewal, and monitoring and record keeping). This section describes each of these administrative requirements and their estimated costs.

❖ *Initial NPDES permit application*

The proposed §316(b) New Facility Rule requires all new facilities subject to this regulation to submit information regarding the location, construction, design, and capacity of their proposed CWIS as part of their initial NPDES permit application. Activities and costs associated with the initial permit application include:

- ***start-up activities:*** reading and understanding the rule; mobilizing and planning; and training staff;

- ***general permit application activities:*** developing drawings that show the physical characteristics of the source water; documenting the littoral zone; developing a description of the CWIS's configuration; developing a facility water balance diagram; developing a narrative of operational characteristics; submitting materials for review by the Director; and keeping records;

- ***source water baseline characterization activities:*** developing a sampling plan; biweekly sampling; profiling the source water biota; identifying critical species; submitting the study for review by the Director; record keeping; and developing a final study based on review by the Director;

- ***source water baseline monitoring capital and O&M costs:*** laboratory analysis of samples;

- ***CWIS flow standard activities:*** developing information characterizing flow; performing engineering calculations; submitting data and analysis for review; and keeping records;

- ***CWIS velocity standard activities:*** developing a narrative description; performing engineering calculations; submitting data and analysis for review; revising analysis based on state review; and keeping records;

- ***CWIS 100 percent recirculation standard activities:*** developing a narrative description; performing engineering calculations; documenting blowdown minimization; submitting data and analysis for review; and keeping records;

- ***additional design and construction technology implementation plan:*** developing a narrative description; performing engineering calculations; submitting data and analysis for review; and keeping records.

Table 6-7 lists the estimated costs of each of the initial NPDES permit application activities described above. The specific activities that a facility will have to undertake depend on the facility's source water body type and the location of its CWIS relative to the water body's littoral zone. The typical cost a facility that is required to implement all the activities would incur for its initial NPDES permit application is estimated to be $53,382.

Table 6-7: Cost of Initial NPDES Permit Application Activities ($1999)

Activity	Estimated Cost
Start-up activities†	$1,380
General permit application activities†	$7,012
Source water baseline characterization activities†	$12,405
Source water baseline monitoring capital and O&M costs†	$20,000
CWIS flow standard activities	$2,595
CWIS velocity standard activities	$4,690
CWIS 100 percent recirculation standard activities	$2,878
Additional design and construction technology implementation plan	$2,422
Typical Initial NPDES Permit Application Cost	$53,382

† The costs for these activities are incurred in the year prior to the permit application.

Source: U.S. EPA, Information Collection Request for Cooling Water Intake Structures, New Facility Proposed Rule, July 2000.

❖ *NPDES permit renewal*

Each new facility operating a CWIS will have to renew its NPDES permit every 5 years. Permit renewal requires collecting and submitting the same type of information as required for the initial permit application. EPA expects that facilities can use some of the information from the initial permit. Building upon existing information is expected to require less effort than developing the data the first time.

Table 6-8 lists the estimated costs of each of the NPDES repermit application activities. The typical cost a facility that is required to implement all the renewal activities would incur for its NPDES permit renewal is estimated to be $44,230.

Table 6-8: Cost of NPDES Repermit Application Activities ($1999)

Activity	Estimated Cost
Start-up activities†	$471
General permit application activities†	$3,287
Source water baseline characterization activities†	$11,319
Source water baseline monitoring capital and O&M costs†	$20,000
CWIS flow standard activities	$2,595
CWIS velocity standard activities	$3,425
CWIS 100 percent recirculation standard activities	$2,151
Additional design and construction technology implementation plan	$982
Typical Initial NPDES Permit Application Cost	$44,230

† The costs for these activities are incurred in the year prior to the application for a permit renewal.

Source: U.S. EPA, Information Collection Request for Cooling Water Intake Structures, New Facility Proposed Rule, July 2000.

❖ ***Monitoring, record keeping, and reporting***

All new facilities subject to the proposed §316(b) New Facility Rule are required to monitor to show compliance with the standards set forth in the rule. Facilities must keep records of their monitoring activities and report the results in a yearly status report. Monitoring, record keeping, and reporting activities and costs include:

- ***biological monitoring (impingement):*** collecting monthly samples; identifying and enumerating organisms; performing statistical analyses; and record keeping;
- ***biological monitoring (entrainment):*** collecting biweekly samples; identifying and enumerating organisms; performing statistical analyses; and record keeping;
- ***velocity monitoring:*** monitoring average through-technology velocity; analyzing data; and record keeping;
- ***weekly visual inspections:*** visually inspecting all installed technologies; and record keeping;
- ***yearly status report activities:*** reporting on inspection and maintenance; detailing velocity monitoring results; detailing biological monitoring results; compiling and submitting the report; and record keeping;

Table 6-9 lists the estimated costs of each of the monitoring, record keeping, and reporting activities described above. The specific activities that a facility will have to undertake depend on the facility's source water body type and the location of its CWIS relative to the water body's littoral zone. The typical cost a facility will incur for its monitoring, record keeping, and reporting activities is estimated to be $79,245.

Table 6-9: Cost of Annual Monitoring, Record Keeping, and Reporting Activities ($1999)

Activity	Estimated Cost
Biological monitoring (impingement)	$17,986
Biological monitoring (entrainment)	$38,675
Velocity monitoring	$4,269
Weekly visual inspections	$6,931
Yearly status report activities	$11,384
Typical Monitoring, Record Keeping, and Reporting Cost	$79,245

Source: U.S. EPA, Information Collection Request for Cooling Water Intake Structures, New Facility Proposed Rule, July 2000.

6.2 FACILITY-LEVEL COSTS

The cost estimates presented in this section are based on the unit costs presented in the previous section and assume that a facility will always choose the least-cost response among the feasible compliance responses. Some compliance responses may not be feasible for certain facilities because of facility-specific characteristics or conditions. EPA developed unit costs and evaluated facility-level costs associated with Compliance Response 1 (reconfiguring cooling water systems from once-through to recirculating or switching to a water other than those of the U.S.), Compliance Response 3 (changing the distance from the littoral zone and implementing requirements based on the new distance from the littoral zone), and Compliance Response 4 (implementing requirements based on water body type and distance from littoral zone). The feasibility of some methods of changing the cooling system design so that the facility would no longer be subject to the proposed §316(b) New Facility Rule (part of Compliance Response 1) or changing the source water body type (Compliance Response 2) could not be evaluated and costed with the information publicly available for new facilities. The estimated facility-level and national-level costs may be overstated, if these excluded responses are less expensive than the assumed response for some facilities.

6.2.1 New Electric Generators

EPA used the unit cost estimates discussed in Section 6.1 to estimate potential compliance costs of the 40 projected in scope electric generators.[7] Facility-specific information on proposed CWIS characteristics was available for the seven facilities identified from the NEWGen database. For these facilities, EPA determined the likely requirements to comply with the proposed §316(b) New Facility Rule. Six of the remaining 33 facilities are assumed to have characteristics similar to the seven analyzed facilities. These are assumed to be combined-cycle facilities projected to begin operation between 2004 and 2009. The Agency calculated the average cost for the seven facilities and applied this average to the remaining six facilities. Costs for the additional 27 facilities projected to begin operation between 2011 and 2020 were calculated based on the characteristics of five model plants.

The following sections present brief profiles of the characteristics of the seven NEWGen electric generating facilities, their compliance requirements and costs, and a summary of the assumptions used to cost the 27 facilities projected to begin operation between 2011 and 2020.

❖ ***GenA***

The GenA facility proposes to withdraw water from a freshwater stream or river for its planned 750 MW plant. The facility plans to use an infiltration gallery or a radial well (Ranney collector) which would be located at the bottom of the river in a pool between two dams and is assumed to be adequately below/outside the littoral zone to be considered to be in the category of at least 50 meters outside the littoral zone. Based on the information provided by the state siting board, EPA estimates that the facility will not need to make any alterations to meet the criteria of the proposed §316(b) New Facility Rule. The facility's estimated water withdrawal needs of 1.9 to 4.4 MGD (average annual flow expected to be 2.6 MGD) for its cooling tower make-up water are less than 25 percent of the source water 7Q10 and less than 5 percent of the source water mean annual flow. The facility estimates that its intake velocity will be less than 0.1 fps under maximum sustained withdrawal conditions.

❖ ***GenB***

The GenB facility proposes to withdraw cooling water from either a freshwater stream or river or from shallow ground wells for its planned 1,100 MW plant. The facility plans to use a multiple cell evaporative cooling tower, so the cooling water will serve as make-up water for the tower. EPA estimates that the facility meets all the technological and locational criteria for the proposed §316(b) New Facility Rule based on the information in its NPDES permit application on (1) the length of its proposed intake pipeline (about 300 feet from the shoreline which is assumed to be more than 50 meters outside the littoral zone); (2) the estimated volume of cooling water needed (19.4 MGD, which is less than 25 percent of the 7Q10 flow; this flow volume is also less than 5 percent of the 7Q10 flow and therefore is assumed to be less than 5 percent of the mean annual flow since waterbody 7Q10 flow is lower than average flow); (3) that the facility will use a recirculating system; and (4) the expected intake velocity of less than 0.5 fps (a wedge wire screen will be used).

❖ ***GenC***

For the GenC facility, EPA only had access to limited facility and intake information from its raw water supply contract. The facility plans to withdraw cooling water from a lake or reservoir for its planned 510 MW plant. Based on the volume of available water the agreement specifies, EPA used an estimated intake flow of 10 MGD (6944 gpm). From the site map attached to the agreement, EPA surmised that the facility uses either two canals or a canal and an intake pipe to draw water from the lake. Based on the diversion point and site maps, EPA estimated that the facility would need to increase the depth of both intake canals or extend its intake pipe and increase the depth of its one canal to locate its intake outside the littoral zone. Dredging and widening the canals is estimated to cost $236,000. If the total design intake flow alters the natural stratification of the lake, the facility may incur additional costs to further alter the intake. This seems unlikely given the size of the lake.

❖ ***GenD***

The GenD facility plans to withdraw cooling water from an estuary or tidal river for use in the cooling towers of its planned 525 MW plant. Based on its application to the state site evaluation committee, the facility's estimated design intake flow of 6.5 MGD will be less than 1 percent of the tidal prism volume. The facility will use cooling towers for a recirculating cooling system. The intake will incorporate a modified, Ristroph type traveling screen with an intake velocity of less than or equal to 0.5 fps. The relatively low intake flow and velocity, and the facility's plans to use a traveling screen equipped with fish baskets, a spray wash system, and a fish return channel to return impinged marine life back to the river is likely to meet the requirement for implementing technologies that maximize survival of impinged fish and minimize entrainment of eggs and larvae. EPA believes that the facility meets all the technological and locational criteria for the proposed §316(b) New Facility Rule.

❖ ***GenE***

GenE proposes to withdraw cooling water from a freshwater stream or river for use in the wet/dry cooling tower of its planned 475 MW plant. EPA assumed that the intake pipe would be within the littoral zone, in the absence of

[7] See *Chapter 5: Baseline Projections of New Facilities* for detailed information on EPA's methodology for determining the number of new facilities.

information on intake location. Since the source water is a sizable river and the facility will use a recirculating system with a relatively small flow of 6.9 to 10.4 MGD, EPA assumed that the facility would meet the requirements for design intake flow and recirculation. The facility plans to use Johnson screens or the equivalent, which should meet the criteria for a design intake flow of no more than 0.5 fps. Using Johnson screens and a relatively small intake flow and velocity, the facility is likely to meet the requirement for implementing technologies that maximize survival of impinged fish and minimize entrainment of eggs and larvae. Therefore, the facility is expected to meet all the technological and vocational criteria for the proposed §316(b) New Facility Rule.

❖ *GenF*

Only limited information is available for the GenF facility, including a drawing of the planned collector well (radial well) cooling water intake system. The facility plans to withdraw up to 3.5 MGD of cooling water from a freshwater stream or river through collector laterals that appear to lie 20 feet below the river bottom. EPA assumed that the lateral wells are adequately below/outside the littoral zone to be considered to be in the category of at least 50 meters outside the littoral zone. Based on the relatively small flow, which the facility information indicates is less than 0.5 percent of the lowest flow recorded in the river, the facility's total design intake flow meets the flow requirements. A radial well is highly likely to withdraw water at a rate of less than 0.5 fps, so the Agency assumed that the facility would meet the intake velocity criteria.

❖ *GenG*

The GenG facility plans to withdraw cooling water from a system of reservoirs for its planned 1,016 MW plant. The intake pipes appear to be nearly 75 meters from shore and about 15 feet below the surface of the water at normal water level. Based on this estimated location, EPA assumed that the CWIS would be located less than 50 meters outside the littoral zone. The facility is likely planning to use a recirculating system since the design intake flow of 8.8 MGD is relatively small. The facility plans to use Johnson screens on its intakes, which provide an intake velocity of no more than 0.5 fps. Using Johnson screens and a relatively small intake flow and velocity, the facility is likely to meet the requirement for not altering the natural stratification of the source water. The facility is projected to extend its intake pipes in order to move the location to 50 meters outside the littoral zone and therefore no longer be subject to the technology criteria (Compliance Response 3). Extending its intake piping is estimated to cost $162,000. The facility may also incur costs related to the criteria for design intake flow not to alter the natural stratification of the source water.

❖ *2011 to 2020 facilities*

EPA used five model plants to develop the costs for the 27 facilities projected to begin operation between 2011 and 2020. The first three model plants are coal-fired facilities with 800 MW capacity and the following characteristics:

- once though system on an estuary (Coal1, 9, and 13);
- recirculating system on an estuary (Coal 2-4, 6-8, 10-12, and 14-16); and
- once through system on a nontidal river (Coal5).

The other two model facilities are 723 MW combined-cycle facilities with the following characteristics:

- once through system on an estuary (CC1, 5, and 9); and
- recirculating system on a nontidal river (CC2-4, 6-8, and 10-11).

EPA assumed that these facilities would continue the trend of offshore submerged intakes with screens systems.

Table 6-10 summarizes the expected compliance response and the associated costs for each facility. Appendix B provides more detailed information on each facility, including its water body type, the expected compliance response of each facility, and the capital costs, if any, associated with the expected action.

Table 6-10: Estimated Compliance Costs for Specific Electric Generator Facilities ($1999)

Facility	Category (Source Water)	Projected Compliance Response	Estimated Cost
GenA	Freshwater stream or river	None	$0
GenB	Freshwater stream or river	None	$0
GenC	Lake or reservoir	Deepen two canals	one-time: $236,000
GenD	Estuary or tidal river	None	$0
GenE	Freshwater stream or river	None	$0
GenF	Freshwater stream or river	None	$0
GenG	Lake or reservoir	Extend piping	one-time: $162,000
Gen1-6	n/a	n/a	one-time: $56,856
Coal1, 9, 13	Estuary or tidal river	Install a cooling tower; widen the intake; add traveling screens with fish handling equipment	one-time: $15,227,000 annual: $3,378,000
Coal2-4, 6-8, 10-12, 14-16	Estuary or tidal river	Add fish handling equipment	one-time: $33,000 annual: $5,700
Coal5	Freshwater stream or river	Widen the intake; extend the pipe	one-time: $5,364,200
CC1, 5, 9	Estuary or tidal river	Install a cooling tower; add fish handling equipment	one-time: $2,940,000 annual: $697,400
CC2-4, 6-8, 10-11	Freshwater stream or river	Extend the pipe	one-time: $162,000

† Not including administrative costs.

Source: Summary information from Appendix B.

Each facility subject to the proposed §316(b) New Facility Rule will incur administrative costs in addition to the estimated capital costs. These costs include one-time costs (initial permit application) and recurring costs (permit renewal, and monitoring, record keeping, and reporting), and depend on the facility's water body type and the location of its CWIS relative to the water body's littoral zone. Table 6-11 presents the costs for the administrative activities and the estimated capital, and operation and maintenance costs for the 40 new electric generators.

Table 6-11: Cost Estimates for Electric Generating Facilities (unit costs, $1999)

Facility Name	No. of Facilities	One-Time Costs		Recurring Costs		
		Capital Technology	Initial Permit Application	O&M	Permit Renewal	Monitoring, Record Keeping, & Reporting
GenA	1	$0	$48,082	$0	$41,098	$72,314
GenB	1	$0	$50,960	$0	$43,250	$72,314
GenC	1	$236,000	$43,392	$0	$37,673	$68,045
GenD	1	$0	$53,382	$0	$44,232	$79,245
GenE	1	$0	$53,382	$0	$44,232	$79,245
GenF	1	$0	$48,082	$0	$41,098	$72,314
GenG	1	$162,000	$53,382	$0	$44,232	$79,245
Gen1-6	6	$56,857	$50,095	$0	$42,259	$74,675
Coal1, 9, 13	3	$15,227,000	$53,382	$3,378,000	$44,232	$79,245
Coal2-4, 6-8, 10-12, 14-16	12	$33,000	$53,382	$5,700	$44,232	$79,245
Coal5	1	$5,364,200	$48,082	$0	$41,098	$72,314
CC1, 5, 9	3	$2,940,000	$53,382	$697,400	$44,232	$79,245
CC2-4, 6-8, 10-11	8	$162,000	$53,382	$0	$44,232	$79,245

Source: *Summary information from Appendix B and the Information Collection Request for Cooling Water Intake Structures, New Facility Proposed Rule, July 2000.*

6.2.2 New Manufacturing Facilities

EPA used the following process to develop cost estimates for new manufacturing facilities affected by the proposed §316(b) New Facility Rule:

- Project the likely characteristics of new in scope manufacturing facilities.
- Assess whether each facility is likely to be in compliance with the requirements of the proposed §316(b) New Facility Rule. If a facility is projected to be out of compliance, determine likely compliance responses.
- Estimate costs for the likely compliance responses at each facility.

❖ ***Projected characteristics of new facilities***

As described in Chapter 5, EPA projected the number of new manufacturing facilities for each SIC code in the manufacturing categories that typically use the greatest amount of cooling water and therefore are the most likely facilities to be subject to the proposed §316(b) New Facility Rule. To determine if these facilities must take compliance actions to meet the proposed requirements, EPA needed to estimate the likely characteristics of these new facilities. Important characteristics in assessing facility compliance with the rule's requirements and determining estimated compliance costs include: source water body type, intake flow volume, use of once-through or recirculating cooling systems, intake location (e.g., shoreline, offshore submerged), and intake control technologies already in place. Since facilities with the same SIC code generally have similar operations and generate similar products, EPA assumed that the characteristics of new facilities in a given SIC code will be similar to the characteristics of existing facilities in that same SIC code. EPA also considered current trends in facilities that have begun operation in more recent years. For example, a review of available data for facilities starting up in the last ten years indicates that newer facilities are much more likely to have at least partially recirculating cooling systems than older facilities. Therefore, EPA projected that a higher percentage of the new facilities would be recirculating than was indicated by existing facility data. EPA used available data from existing manufacturing facilities that responded to the §316(b) Screener Questionnaire.

EPA evaluated the characteristics listed above for all the existing facilities in each SIC code, and used those characteristics to project the characteristics for the one or more projected new facilities. If only one new facility was projected for a given SIC code, EPA generally used the following conventions:

- ***source water type:*** most common water body among the existing facilities;
- ***flow:*** median of the flows for existing facilities;
- ***intake location:*** most common intake location among existing facilities;
- ***control technology type:*** most common technologies in use at existing facilities; and
- ***cooling system type:*** most common type, with a bias toward recirculating or combined recirculating and once-through when the type of system among existing facilities was very mixed.

When more than one new facility was projected for a given SIC code, EPA generally split the existing facilities by waterbody type or by recirculating versus once-through and determined one new projected facility's characteristics based on one set of existing facilities and another new projected facility's characteristics based on the other set of existing facilities. Based on trends, EPA used a bias toward certain characteristics such as recirculating cooling systems, offshore intakes, and passive screens. Since the trend for new facilities is toward the use of cooling towers, flows used may be lower than those for the existing facilities in some cases.

❖ *Projected baseline compliance*

Based on the new manufacturing facility characteristics, determined as described above, EPA assessed whether a facility is likely to comply with the requirements of the proposed §316(b) New Facility Rule for its particular type of water body and intake location. Assumptions made in this assessment include the following:

- A facility with a shoreline, canal, or bay/cove intake was assumed to be in the littoral zone. A facility with an offshore intake was assumed to be less than 50 meters outside the littoral zone.[8]
- A facility with a passive screen was assumed to meet the 0.5 fps velocity criteria.
- A facility with a recirculating system is assumed to meet the intake flow criteria since most existing facilities (e.g., more than 90 percent of utilities) with recirculating systems would meet the intake flow criteria. Most once-through facilities were also assumed to meet the intake flow criteria since manufacturing facilities typically have much lower intake flows than utilities. If a once-through facility was projected to not meet the intake flow criteria, it was projected to switch to a recirculating system and then meet the criteria.
- All facilities were assumed to have one intake, which seems reasonable for manufacturers since most utilities have one or two intakes and typically have much higher flows.

❖ *Estimated costs*

The unit costs discussed in Section 6.1 were used to develop cost estimates for each of the new projected manufacturing facilities that needs to take compliance actions to meet the requirements of the proposed §316(b) New Facility Rule. Unit costs were based on flow. Costing assumptions related to flow include the following:

- If a facility has a once-through system only and is projected to switch to a 100 percent recirculating system as a compliance response, the flow used for costing the recirculating cooling tower is 15 percent of the original flow since the flow will be reduced in the new recirculating system.
- If a facility is planned as a combined once-through and recirculating system, the facility is assumed to have 10 percent of the initial flow attributed to recirculating and 90 percent to the once-through part of the system.
- If a facility is planned as a combined once-through and recirculating system and is projected to switch to a 100 percent recirculating system as part of its compliance response, the estimated cost of a cooling tower is based on the 90 percent of the original flow that was attributed to the once-through portion of the system. This 90 percent portion of the original flow is reduced to 15 percent of its original value and then added to the other 10

[8] The majority of the intakes of units in the EIA-767 database that are likely to use a water of the U.S. are less than 75 meters from shore, with a median distance of about 15 meters.

percent of the original flow to calculate the estimated flow once the system becomes 100 percent recirculating. This new flow is then used to calculate the estimated cost of any other technology compliance actions.

Estimated costs were calculated for all projected compliance responses, including adding technologies (for example, cooling towers to switch to a recirculating system), and administrative costs such as monitoring and permitting. Other technology costs (e.g., passive screens, cooling towers, widening intakes) include a capital cost for the equipment itself and associated installation costs. Some of these technologies also include an annual O&M cost, since these costs were significant for some technologies (e.g., cooling towers and traveling screens with fish baskets). O&M costs are negligible for some other technologies. Administrative costs were estimated as either annual costs or periodic costs based on the frequency of the activity. For example, monitoring and reporting occurs annually while applying for a permit occurs once every five years. For comparison purposes, all costs are annualized over a 30 year period using a seven percent discount rate.

Table 6-12 shows the estimated compliance costs for the projected new manufacturing facilities. The table only shows the 29 facilities projected for the forecasting period 2001 to 2010. As explained in *Chapter 5: Baseline Projections of New Facilities*, the 29 facilities projected to begin operation between 2011 and 2020 are assumed to be identical to the first 29 facilities. Therefore, each manufacturing facility presented in Table 6-12 represents two future facilities. Appendix B provides more detailed information on the estimated cost for each facility, including its water body type, whether the facility's baseline design meets compliance requirements, the expected compliance response of each facility and the capital costs, if any, associated with the expected action.

Table 6-12: Cost Estimates for Manufacturing Facilities (unit costs, $1999)

Facility ID	One-Time Costs		Recurring Costs		
	Capital Technology	Initial Permit Application	O&M	Permit Renewal	Monitoring, Record Keeping, & Reporting
new 2812-1	$24,000	$50,960	$0	$43,249	$72,314
new2813-1	$1,752,000	$53,382	$419,300	$44,231	$79,245
new2819-1	$320,000	$7,194	$89,000	$4,654	$0
new2819-2	$1,512,000	$53,382	$357,000	$44,231	$79,245
new2821-1	$170,000	$48,082	$0	$41,098	$72,314
new2821-2	$300,000	$43,392	$0	$37,673	$72,314
new2821-3	$47,000	$50,504	$0	$42,080	$79,245
new2824-1	$0	$53,382	$0	$44,231	$79,245
new2833-1	$0	$48,082	$0	$41,098	$72,314
new2834-1	$410,000	$7,194	$111,000	$4,654	$0
new2841-1	$375,000	$7,194	$102,000	$4,654	$0
new2865-1	$0	$48,082	$0	$41,098	$72,314
new2869-1	$605,000	$7,194	$157,000	$4,654	$0
new2869-2	$605,000	$7,194	$157,000	$4,654	$0
new2869-3	$21,000	$50,960	$0	$43,249	$72,314
new2869-4	$21,000	$50,960	$0	$43,249	$72,314
new2869-5	$21,000	$50,960	$0	$43,249	$72,314

Table 6-12: Cost Estimates for Manufacturing Facilities (unit costs, $1999)

Facility ID	One-Time Costs		Recurring Costs		
	Capital Technology	Initial Permit Application	O&M	Permit Renewal	Monitoring, Record Keeping, & Reporting
new2869-6	$400,000	$48,082	$0	$41,098	$72,314
new2869-7	$481,000	$48,082	$483,700	$41,098	$72,314
new2869-8	$481,000	$48,082	$483,700	$41,098	$72,314
new2869-9	$0	$53,382	$0	$44,231	$79,245
new2873-1	$91,000	$53,382	$5,200	$44,231	$79,245
new2874-1	$44,000	$50,960	$0	$43,249	$72,314
new2899-1	$299,000	$7,194	$84,000	$4,654	$0
new3312-1	$1,450,000	$50,504	$342,000	$42,080	$79,245
new3312-2	$21,000	$50,960	$0	$43,249	$72,314
new3312-3	$700,000	$43,392	$0	$37,673	$72,314
new3316-1	$0	$53,382	$0	$44,231	$79,245
new3353-1	$3,000	$50,960	$0	$43,249	$72,314

Source: *Summary information from Appendix B and the Information Collection Request for Cooling Water Intake Structures, New Facility Proposed Rule, July 2000.*

6.3 Total Facility Compliance Costs

EPA estimated the national compliance costs for the proposed §316(b) New Facility Rule based on the facility-level costs discussed in Section 6.2. The costs developed in this section represent the total compliance costs for new facilities expected to begin operation between 2001 and 2020.[9] EPA estimated total compliance costs over the first 30 years of the proposed regulation (i.e., 2001 to 2030). Accordingly, the Agency considered all compliance costs incurred by each of the 98 facilities over this 30-year time period.[10]

The analysis assumes the following distribution of new facilities over the 20-year forecasting period:

- The seven NEWGen facilities will begin operation in the "projected on-line year" reported in the RDI database. For these facilities, the dates of initial commercial operation range between 2001 and 2003.
- The six extrapolated generators will begin operation between 2004 and 2009.
- The on-line dates of the 33 generators expected to begin operation between 2011 and 2020 are based on the relative magnitude of forecasted capacity additions over that time period.
- The years of initial operation for the 58 projected manufacturing facilities are assumed to be evenly distributed over the 20-year forecasting period.

[9] The national cost estimate presented in this chapter only accounts for *private costs* directly incurred by facilities. It does not represent total *social cost* of the proposed §316(b) New Facility Rule.

[10] This approach does not account for all compliance costs incurred by the 98 projected facilities because the analysis disregards costs incurred after 2030. For example, for a facility estimated to begin operation in 2015, the analysis would only include the first 16 years of costs in the national aggregate.

EPA calculated the present value of each cost category using a seven percent discount rate. The following formula was used to calculate the present value of each year's cost:[11]

$$Present\ Value_x = \frac{Cost_{x,t}}{(1 + r)^t}$$

where:

$Cost_{x,t}$	=	Costs in category x and year t
x	=	Cost category
r	=	Discount rate (7% in this analysis)
t	=	Year in which cost is incurred (2001 to 2030)

Total present value for each cost component was derived by summing the present value of each year's cost. Finally, EPA calculated annualized costs using the following formula:

$$Annualized\ Cost_x = PV_x \times \frac{r \times (1 + r)^n}{(1 + r)^n - 1}$$

where:

x	=	Cost category
PV_x	=	Present value of compliance costs in category x
r	=	Discount rate (7% in this analysis)
n	=	Amortization period (30 years)

Table 6-13 presents the estimated national aggregate of facility compliance costs of the proposed §316(b) New Facility Rule by cost category. The table shows that the present value of total facility compliance costs is estimated to be $150.5 million. The 40 electric generators account for $79.7 million of this total, and the 58 manufacturing facilities for $70.7 million. Total annualized cost for the 98 facilities is estimated to be $12.1 million. Of this, $6.4 million will be incurred by electric generators and $5.7 million by manufacturing facilities.

[11] Calculation of the present value assumes that the cost is incurred at the end of the year.

Table 6-13: Total Facility Costs of Compliance with the Proposed §316(b) New Facility Rule (in millions $1999)

Industry Category (Number of Facilities Affected)	One-Time Costs		Recurring Costs			Total
	Capital Technology	Initial Permit Application	O&M	Permit Renewal	Monitoring, Record Keeping & Reporting	
Total Compliance Costs (present value)						
Electric Generators (40)	$22.45	$1.05	$39.33	$1.53	$15.38	$79.74
Manufacturing Facilities (58)	$12.22	$1.38	$34.26	$2.14	$20.74	$70.74
Total (98)	**$34.67**	**$2.43**	**$73.60**	**$3.67**	**$36.12**	**$150.49**
Annualized Compliance Costs						
Electric Generators (40)	$1.81	$0.08	$3.17	$0.12	$1.24	$6.43
Manufacturing Facilities (58)	$0.98	$0.11	$2.76	$0.17	$1.67	$5.70
Total (98)	**$2.79**	**$0.20**	**$5.93**	**$0.30**	**$2.91**	**$12.12**

Source: *Summary information from Appendix B and the Information Collection Request for Cooling Water Intake Structures, New Facility Proposed Rule, July 2000.*

6.4 Case Study Facility Costs

Estimating compliance costs for the §316(b) New Facility Rule requires projecting the types of facilities that will be built in the future. EPA's projections do not include some facility types that could incur higher costs than estimated here or more significant impacts, if these types of plants were constructed. EPA estimated compliance costs for eight additional case studies. These are four high flow "worst case" electric generators and four manufacturing facilities in industries not covered in the previous sections. The costs for these case study facilities are not included in the estimated national costs of the rule, because EPA has no information to indicate that these types of facility are being planned.

EPA determined the worst case scenario for new electric generators would be a large nuclear or coal-fired power plant located on an estuary. Therefore, the Agency estimated costs for hypothetical large nuclear and coal-fired electricity generating plants. These plants' characteristics were defined as follows:

- ***source water type:*** estuary, no specific location (state or region) is assumed;
- ***flow:*** maximum flow for a recirculating system and the average flow for the highest third of the once-through systems based on the EIA 767 database for both coal-fired and nuclear plants;
- ***intake location:*** shoreline intake;
- ***control technology type:*** minimal control technologies were assumed (i.e., fixed screen);
- ***cooling system type:*** recirculating and once-through systems based on EIA 767 database.

Based on the power plant characteristics, determined as described above, EPA assessed the modifications these plants would have to make to comply with this rule's requirements. Assumptions made in this assessment include the following:

- Plants with a shoreline intake were assumed to be in the littoral zone.
- Plants with these high flows would not meet the velocity requirement.

- Each plant was assumed to have one intake, which seems reasonable since most power plants have one or two intakes.

Based on these initial basic assumptions, EPA assumed that, in the baseline, plants with recirculating systems would meet only the 100 percent recirculating requirement for estuaries in the proposed rule and plants with once-through systems would not meet any of the requirements. Therefore, all the new plants would need to make modifications to their original design in order to comply.

EPA used the same assumptions for the new manufacturers in these analyses as it did for the analyses of new manufacturers performed in Section 6.2.

The unit costs discussed in Section 6.1 were used to develop cost estimates for these hypothetical plants. Unit costs for technologies were based on flow, so the estimated flow for a plant was important in calculating the estimated cost for a given technology. Two of the plants were assumed to be once-through only and are projected to switch to a 100 percent recirculating system as a compliance action. The flow used for costing the recirculating cooling tower is 10 percent of the original flow since the flow will be reduced in the new recirculating system.

For the new manufacturing facilities flows were estimated using the following assumptions:

- If a facility is once-through only and is projected to switch to a 100 percent recirculating system as a compliance response, the flow used for costing the recirculating cooling tower is 15 percent of the original flow since the flow will be reduced in the new recirculating system.

- If a facility is planned as a combined once-through and recirculating system, the facility is assumed to have 10 percent of the initial flow attributed to recirculating and 90 percent to the once-through part of the system.

- If a facility is planned as a combined once-through and recirculating system and is projected to switch to a 100 percent recirculating system as part of its compliance response, the estimated cost of a cooling tower is based on the 90 percent of the original flow that was attributed to the once-through portion of the system. This 90 percent portion of the original flow is reduced to 15 percent of its original value and then added to the other 10 percent of the original flow to calculate the estimated flow once the system becomes 100 percent recirculating. This new flow is then used to calculate the estimated cost of any other technology compliance actions.

Estimated costs were calculated for all projected compliance actions, including adding technologies and for administrative costs. Technology costs (e.g., traveling screens with fish baskets, cooling towers, or widening intakes) always include a capital cost portion for the equipment itself and associated installation. Some of these technologies also include an annual O&M cost since these costs were significant for some technologies (e.g., cooling towers or traveling screens with fish baskets). Administrative costs were estimated as either annual costs (monitoring) or periodic costs (permit renewal) based on the frequency of the activity.

Table 6-14 presents the estimated facility compliance costs for the eight hypothetical case study facilities:

- two coal-fired electricity generating plants, one with the maximum flow for a recirculating system ("CoalMax") and the other with the average flow for the highest third of the once-through systems ("CoalAvg") based on the 1995 Form EIA-767 database;

- two nuclear electricity generating plants, one with the maximum flow for a recirculating system ("NucMax") and the other with the average flow for the highest third of the once-through systems ("NucAvg") based on the 1995 Form EIA-767 database; and

- four manufacturing facilities, one each in four of the two-digit SICs for which existing in scope facilities were reported in the screener database ("New SIC xx HF"). These are SIC codes 20 (Food and Kindred Products), 26 (Pulp and Paper), 29 (Petroleum Refining), and 32 (Stone, Clay, Glass and Concrete).

Table 6-14: Case Study Facility Compliance Costs (unit costs, $1999)

Facility	One-Time Costs		Recurring Costs		
	Capital Technology	Initial Permit Application	O&M	Permit Renewal	Monitoring, Record Keeping & Reporting
CoalMax	$13,291,000	$53,382	$400,000	$44,232	$79,245
CoalAvg	$23,471,000	$53,382	$5,275,000	$44,232	$79,245
NucMax	$27,812,000	$53,382	$900,000	$44,232	$79,245
NucAvg	$57,450,000	$53,382	$15,690,000	$44,232	$79,245
New SIC 20	$1,076,000	$48,082	$220,000	$41,098	$72,314
New SIC 26	$124,000	$48,082	$0	$41,098	$72,314
New SIC 29	$217,000	$50,960	$0	$43,250	$72,314
New SIC 32	$4,970,000	$50,960	$1,100,000	$43,250	$72,314

Source: Summary information from Appendix B and the Information Collection Request for Cooling Water Intake Structures, New Facility Proposed Rule, July 2000.

Capital costs for the case study facilities range from $13.3 million to $57.5 million for electric generating plants, and from $124,000 to $5.0 million for manufacturing plants. Except for CoalMax, the costs for electricity generators are substantially higher than the corresponding costs estimated for the 33 projected electric generators. The estimated costs for the additional manufacturing facilities, on the other hand, fall within the range of capital costs estimated for the 58 projected manufacturing plant characteristics. The exception is NewSIC32, which has a total capital cost almost three times that of the highest cost facility among the 58 projected manufacturers.

The results for these case study scenarios show that compliance costs can be sensitive to the specific characteristics of each regulated plant, and that the rule could discourage the construction of very high flow electric generating plants in the future. Given the lack of evidence that such plants are likely to be constructed in the future, however, EPA does not consider the disincentives to construct such very high flow plants as a significant cost of the rule.

6.5 Limitations and Uncertainties

EPA's estimates of the compliance costs associated with the proposed §316(b) New Facility Rule are subject to limitations because of uncertainties about the number and characteristics of the new plants that will be subject to the rule. Projecting the number of new plants in different industries is subject to uncertainties about future industry growth rates and about the portion of new capacity that will come from new greenfield facilities as opposed to expansions at existing plants. This is especially the case when extending forecasts 20 years into the future.

To the extent possible, EPA used information on the characteristics of plants that are now being planned to project the baseline characteristics of facilities affected by the rule. Information on these planned plants and on the characteristics of existing plants that have CWIS provided a basis for projecting the characteristics of new plants beyond those for which plans are available. The estimated national facility compliance costs may be over- or understated if the projected number of new plants is incorrect or if the characteristics of new plants are different from those assumed in the analysis. In particular, the analysis may overestimate the number of plants that will withdraw from a water of the U.S. and thus be subject to the proposed rule, given observed trends toward greater use of recirculating systems and away from the use of water of the U.S. to provide cooling water.

Limitations in EPA's ability to consider a full range of compliance responses may result in an overestimate of facility compliance costs. The Agency was not able to consider certain compliance responses, including the costs of relocating the plant to use a different source water body type and the cost of some methods of changing the cooling system design. Costs will be overstated if these excluded compliance responses are less expensive than the projected compliance response for some facilities.

The estimated costs may be overstated if some compliance responses result in savings in facility construction or operating costs compared with the baseline plant design. Savings such as reduced water pumping costs, smaller pipes, smaller pumping station housing, and smaller size screens due to reduced water use have not been included in the cost estimates. For example, the costs for installing a recirculating cooling tower do not reflect the reduced cost of pumping water that will result from the use of less cooling water. EPA's facility-level and national-level cost estimates also exclude these potential savings to facilities from their compliance responses, and therefore overstate the costs associated with the rule for facilities that choose compliance responses that result in such savings. Finally, estimated costs do not account for reduced energy efficiencies that may result from switching to the use of cooling towers from a once-through cooling system. This energy "penalty" may be considerable and is dependent on specific site characteristics, such as plant type.

REFERENCES

R.S. Means. 1997. *Heavy Construction Cost Data 1998.*

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