03 - 0132

Minnesota Department of Commerce

Background on Nuclear Power in Minnesota

1. *What is nuclear power?*

Generically, nuclear power uses the heat from nuclear fission (the splitting of uranium atoms) to heat water. In turn, the hot water is used to turn a turbine to create electricity.

Prairie Island is a pressurized-water reactor (PWR). PWRs keep water under pressure so that it heats, but does not boil. See Attachment 1 for a picture of a PWR. One loop of water runs out of the reactor core where it is heated, through a steam generator where its heat is transferred to a second loop of water, and back to the reactor core to be reheated. A second loop of water runs out of a condenser where it is cooled, into the steam generator to gain heat from the first loop, past a turbine to create electricity, and back to the condenser again. In this way, water from the reactor and the water in the steam generator that turns the turbine never mix; most of the radioactivity stays in the reactor area. Finally, there is a third loop of cooling water which runs into and out of the condenser to cool the second loop.

By contrast, Monticello is a boiling water reactor (BWR). BWRs are similar to PWRs but actually boil the water. See Attachment 1 for a picture of a BWR. At Monticello, the water in the core is boiled into steam, which is sent through a turbine to create electricity, through a condenser where it is cooled, and back to the reactor core. There is a second loop of cooling water which runs into and out of the condenser to cool the first loop.

2. *How does the reactor work?*

In both PWRs and BWRs the reactor operates in the same manner. Uranium-235, representing about 3.5 percent of the Uranium in the reactor fuel absorbs a neutron, transforming U-235 into U-236. Since U-236 is unstable, it breaks down or "fissions" into a small amount of heat, 2 smaller radioactive elements, plus new neutrons. These new neutrons can also be absorbed by some of the surrounding U-235, creating more U-236 fissions and, thus, a chain reaction. In addition, some of the neutrons are absorbed by Uranium-238, which eventually leads to Plutonium. When the chain reaction is self-sustaining, the reactor is said to have reached criticality.

The chain reaction is controlled in different ways, but most prominently through control rods. Basically, control rods are made of materials that can absorb neutrons without fissioning. Control rods are separate from fuel rods, which contain the Uranium. More control rods absorb more neutrons, slowing the chain reaction while fewer control rods absorb fewer neutrons, speeding up the chain reaction. Thus, through the control rods, criticality is maintained without allowing a run-away chain reaction. In power reactors,

if a run-away chain reaction occurs, the nuclear fuel overheats and begins to melt; it would not explode.

3. *So what happened to Three Mile Island and Chernobyl?*

At Three Mile Island, a combination of two failures – a main feedwater pump failed and a valve in the emergency feedwater system was left closed after a test – caused some of the fuel to melt and the release of a small amount of radiation.

At Chernobyl, the reactor was undergoing a test. During the test, the power level dropped too low, which causes instability in Chernobyl-type reactors. The operators continued the test when they should have shutdown. The result was that the fuel overheated and turned the water into steam. The pressure from the steam led to a "steam explosion" which destroyed the area around the reactor, leading to fires and a release of radiation.

A summary from the U.S. Nuclear Regulatory Commission (NRC) of these accidents is included as Attachment 2.

4. *How much nuclear power does Minnesota use?*

In 2001 Minnesotans used a total of approximately 61,725 Giga-Watt Hours[1] (GWh) of electricity produced by all kinds of fuel,[2] while Xcel provided a total of approximately 29,675.3 GWh of this total to its Minnesota customers. Approximately 19 percent of the GWh used by Minnesotans and 40 percent of the GWh used by Xcel's customers comes from nuclear facilities (Prairie Island and Monticello). See Table 1 below.

Table 1: Nuclear Power in Minnesota[3]

Production	2001 GWh	% of Minn.	% of Xcel
Prairie Island	7,912.7	12.8%	26.7%
Monticello	3,876.3	6.3%	13.1%
Total Nuclear	11,789.0	19.1%	39.7%

5. *So, what is a giga-watt hour?*

Note the following relationships:

1	Giga-Watt Hour	equals
1,000	Mega-Watt Hours	equals
1,000,000	Kilo-Watt Hours	equals
1,000,000,000	Watt Hours	

[1] This is a preliminary number; the final number may change.
[2] Fuels include coal, natural gas, wind, etc.
[3] Data from Xcel's September 19, 2002 Electric Utility Annual Report-Correction (REIS).

It takes 100 watt-hours to light a one hundred-watt light bulb for one hour. Therefore, 1 giga-watt hour can light up 10 million hundred-watt light bulbs for one hour each (to determine this, divide 1 billion watt-hours (1 GWh) by 100).

6. *What is the cost to ratepayers for nuclear power?*

Xcel's Prairie Island facility is among the cheapest producing facilities it owns. See Table 2 below.

Table 2: Costs at Xcel's Major Power Plants[4]

Plant	Production Expenses per kWh	Primary Fuel
Sherburne County	$0.0131	Coal
A.S. King	$0.0149	Coal
Riverside	$0.0164	Coal
Prairie Island	**$0.0192**	**Nuclear**
High Bridge	$0.0207	Coal
Monticello	$0.0243	Nuclear
Black Dog	$0.0265	Coal
Angus Anson	$0.0737	Natural Gas

7. *What is the cost of the plant at Prairie Island?*

As of the beginning of 2002 the gross plant balance of Prairie Island was $895,031,102 for the generating station and $32,584,176 for the interim storage facility. Thus, the total gross plant balance was $927,615,278. Gross plant balance is the cost of the equipment currently at Prairie Island. This amount is currently scheduled to be fully depreciated in 2007 and was about 67 percent depreciated as of the beginning of 2002.[5]

8. *What kinds of waste result from nuclear power?*

There are two types of radioactive waste from nuclear power plants, high-level waste and low-level waste. The low-level radioactive waste can be defined as everything that is not high-level waste (that is waste from power reactors or bomb making) or Uranium mining tailings. See Attachment 3 for more details on definitions.

9. *What is the low-level waste situation?*

[4] Data taken from Xcel's FERC Form No. 1 filing for the year ended December 31, 2001. For these purposes "major" is defined as plants with over 100 MW of installed capacity and more than 1,000 hours connected to load in 2001.
[5] Data taken from Xcel's 2002 Review of Remaining Lives made February 15, 2002.

Low-level waste is less radioactive and can come from nuclear reactors or other users of radioactive material, like hospitals or research institutes. The NRC has defined four different types of low-level waste, referred to as Class A, Class B, Class C, and Greater than C. Class A has the lowest level of radioactivity and Class C and above has the highest level of radioactivity. Under the Low-Level Radioactive Waste Policy Act of 1980, states have responsibility for disposing of low-level waste. Specifically, states are responsible for disposing Class A, Class B, and Class C waste while Greater than C waste is a federal responsibility.

The states were encouraged by the Low-Level Radioactive Waste Policy Act to join regional compacts to jointly find a single disposal site for all members of the compact. Since low-level waste is less radioactive, it is less hazardous than high-level waste and can be shipped to disposal facilities where it can be packaged, buried in trenches, and covered with soil.

Minnesota is a member of the Midwest Compact along with Indiana, Iowa, Missouri, Wisconsin, and Ohio. The Midwest Compact failed to find a disposal site, voting on June 26, 1997 to halt development of a facility in Ohio. Currently, Minnesota's low-level waste is shipped out of state for disposal at a commercial disposal facility.

10. Where can the low-level waste go?

There have been seven operating commercial facilities in the United States licensed to bury low-level radioactive wastes. They are located at:

- West Valley, New York;
- Maxey Flats near Morehead, Kentucky;
- Sheffield, Illinois;
- Betty, Nevada;
- Hanford, Washington;
- Clive, Utah; and
- Barnwell, South Carolina.

At the present time, only the latter three sites are receiving waste for burial. The Hanford site is accepting waste only from 10 states in the northwest and Rocky Mountains.[6] State law in South Carolina phases out acceptance of non-Atlantic Compact Waste by 2008.[7] Finally, the site in Utah can only receive Class A waste. The owner, Envirocare of Utah, Inc., filed a request to be able to receive all types of low-level waste. A final decision granting the request was issued on July 9, 2001. However, this approval was conditioned on Legislative approval. Envirocare recently determined it would not seek legislative or gubernatorial approval for its Class B and Class C waste proposal.

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[6] These states are Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington, and Wyoming from the Northwest Compact and Colorado, Nevada, and New Mexico from the Rocky Mountain Compact.
[7] The Atlantic Compact consists of South Carolina, Connecticut, and New Jersey.

Currently, the low-level waste from Prairie Island goes to Barnwell, South Carolina but will most likely go to Clive, Utah as South Carolina phases-out accepting non-Atlantic Compact wastes.

11. How much low-level waste does Minnesota produce?

According to the Midwest Compact, in 1998 Minnesota produced a total of 1,316.6 cu. ft. of low level waste by volume and 314.0 curies by activity. In volume terms, about 95 percent of the waste came from utilities. In activity terms about 80 percent of the waste came from utilities. The other sources of waste were academia, government, and industry. The low-level waste originating in Minnesota represents about 0.10 percent of the nation's low-level waste that was disposed in 2000.[8]

12. What is the high-level waste situation?

Each reactor at Prairie Island holds 121 fuel assemblies. Each fuel assembly will eventually fill 1 slot in the spent fuel pool or a single slot in a dry cask. A fuel assembly is a bundle of 179 fuel rods. The fuel rod is a tube about 12 feet long filled with uranium pellets and is as wide as your finger. The reactor can run about a year and a half before it must shut down for refueling and maintenance. During refueling approximately 48 of the fuel assemblies are removed from the reactor and replaced with new fuel.

Spent fuel is highly radioactive because it contains byproducts that were created while the reactor was operating. Some of these byproducts will take many years to decay or lose their radioactivity. The half-life of a radioactive element is the amount of time it takes for one-half of the quantity of that element to decay—either to a stable form, or to another radioactive element in a "decay chain." After ten half-lives, one thousandth of the original concentration is left; after 20 half lives, one millionth. Generally 10 to 20 half lives is called the hazardous life of the waste. Example: Plutonium-239, which is contained in spent fuel, has a half-life of 24,400 years. Thus, Pu-239 is hazardous for at least a quarter million years (24,400 years per half-life x 10 half-lives).

Due to the intense radioactivity and long half-life, a special disposal site is needed for high-level wastes in the long-term. The U. S. Department of Energy is exploring building a long-term, high-level waste disposal site at Yucca Mountain, Nevada.[9] These activities are being paid for by the users of nuclear power by a special, $0.001 per kWh fee. Individual utilities are responsible for the short-term storage needed until the long-term storage site is available.

13. How much have Xcel's ratepayers paid to DOE for high-level waste storage?

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[8] Data from the U.S. Nuclear Regulatory Commission and the Midwest Interstate Low-Level Radioactive Waste Compact Commission.

[9] The latest step taken by DOE was the site recommendation that was approved by Congress in 2002. DOE's schedule calls for site recommendation to be followed by a license application in 2003, construction authorization in 2006, amended license to receive spent fuel in 2008, and initial acceptance of spent fuel in 2010.

As of March 2002 Xcel's ratepayers have paid $360.1 million. This consists of $236.4 million in principle and $123.7 million in interest. Going forward, this will be 1 mil per kWh, or about $11.8 million annually based on 2001 production.

Overall, DOE has collected $20.1 billion from state, federal, and industry sources in principle and interest through March 2002. Of that amount, less than $6 billion has been disbursed. The Defense Waste Account also funds high-level waste storage.

14. When will Yucca Mountain be ready?

In 1982 Congress directed DOE to build a permanent national high-level waste storage facility and begin accepting spent nuclear fuel by January 31, 1998. DOE signed contracts with utilities owning nuclear plants to that effect. However, Yucca Mountain is currently estimated to be ready to accept waste in 2010 at the earliest. The U.S. Government Accounting Office (GAO) issued a report in December 2001 which estimated that Yucca Mountain may not be ready to accept waste until 2015, five years later than the current estimate of 2010. That GAO estimate assumed that no other problems, such as failure of congress to increase the project's budget as needed, occurred. This report noted that DOE is exploring other ways to begin accepting waste in 2010.

15. Since DOE missed its deadline, what happened?

In 1998 Xcel brought a lawsuit against the DOE. Xcel's claim is that DOE breached the contract under which DOE was to begin accepting spent nuclear fuel by January 31, 1998. Xcel's lawsuit seeks more than $1 billion in damages resulting from DOE's breach. The Court of Federal Claims dismissed Xcel's lawsuit. However, on August 31, 2000 the U.S. Court of Appeals for the Federal Circuit in Washington D.C. revived Xcel's lawsuit and sent the case back to the Federal Court of Claims for a determination of damages. At this time, a determination of damages is still pending.

16. Since Yucca Mountain isn't ready, how much space does Prairie Island need?

According to Xcel, Prairie Island would require a total of 2,393 storage spaces on site to operate until the end of Prairie Island's licenses in 2013 and 2014.[10] Current law in effect authorizes a total of 1,971 storage spaces.[11] Thus, 422, more storage spaces are required in order to operate to the end of the current licenses. If Prairie Island's license life were extended significant additional storage would be required.

17. How does a license life get extended?

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[10] 2,653 total assemblies used, less 242 assemblies left in reactor, less 18 consolidated assemblies, equals 2,393 assemblies to store. Data taken from Xcel's Resource Plan 2000 – 2014, filed July 10, 2000.
[11] 1,386 normal spaces in pool, plus 680 spaces in casks, less 47 spaces for dual-core off load, less 48 spaces filled with hardware equals 1,971 storage spaces available. Data taken from Xcel's Resource Plan 2000 – 2014, filed July 10, 2000.

The process of extending the license life of a nuclear power plant is referred to as relicensing. To relicense, the owner of the power plant must file an application with the NRC at least 5 years prior to the expiration of the current license. To allow the staff of the NRC to a review the application's completeness, an application should be submitted at least 6 months prior to the deadline. Monticello's current license expires September 8, 2010. Thus, if Xcel chooses to relicense Monticello, the Company would need to file a relicensing application in early 2005.

At this time several plants in the United States have either completed or started the relicensing process. Five plants representing a total of 10 units have had their applications approved. Ten plants representing a total of 16 units have relicensing applications under review. Several additional plants have indicated an intention to apply for relicensing during the 2003-2005 time frame.

18. What are the options for storing high-level nuclear waste in the short-term?

There are three main sites that could be considered for short-term storage space while the long-term storage site—Yucca Mountain, Nevada—is developed. The three potential sites for short-term storage are Skull Valley, Utah; Yucca Mountain, Nevada; and Prairie Island, Minnesota.

The first potential short-term storage site, on the reservation of the Skull Valley band of Goshute Indians, is being developed by Private Fuel Storage, LLC (PFS). PFS is a group of eight electric utility companies, including Xcel Energy.[12] PFS applied for a license for short-term storage from the NRC on June 20, 1997. At this time a final decision has not been rendered. It is not clear whether the Skull Valley site will be available in a timely manner.

The second option is to create a national short-term storage site at Yucca Mountain. A bill to do this passed both houses of Congress but was vetoed by President Clinton. The veto was not overridden. Considering the time Private Fuel Storage has taken on its application it is unlikely that a national short-term storage site could be ready before Prairie Island would be forced to close.

The third potential short-term storage site is at Prairie Island. There are two places to store fuel at Prairie Island, in the spent fuel pool and in casks on an outdoor, concrete pad. The spent fuel pool has 1,386 normal slots. In addition, the pool has a cask operations area that is normally kept open for operations involving the storage casks. However, 195 removable slots can be placed in the cask operations area of the pool.

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[12] Six members of PFS promised U.S. Sens. Orrin Hatch and Bob Bennett (Utah) that if the Senate approved Yucca Mountain as a permanent waste repository, the companies would not commit funds to building a temporary storage facility in Skull Valley.

Currently, the removable slots and 47 of the normal slots are reserved for a dual-core off-load emergency; this is a requirement of the Public Utilities Commission (PUC). The remaining normal slots (1,386 – 47 = 1,339) will be filled in 2007. However, with approval from the Legislature and potentially the Prairie Island Mdewakanton Dakota (see Question 30) the pool could be "reracked," or expanded for additional storage. This option would cost about $22.4 million and would require NRC and legislative approval.[13] Reracking would provide a total of about 1,920 storage spaces. That is, an additional 534 storage spaces.

Alternatively, Xcel uses large, sealed steel containers to store some of the plant's older used fuel on the Prairie Island Site on a concrete pad. Each cask is almost 17 feet tall, is 8 feet, 6 inches in diameter and provides storage for 40 spent fuel assemblies. The cask walls are about nine inches thick while the top and bottom are about 11 inches thick. Each cask is loaded with spent fuel in the cask operations area of the storage pool. After an inspection of the cask, a custom-built transporter moves it to the storage site—a large concrete pad. Once on the storage pad, monitoring equipment is attached that continuously checks the condition of the cask's lid seals. The cask has no moving parts and is virtually maintenance-free. The storage pad is surrounded by a tall earthen wall and a double security fence. There are other security measures too.

Currently, Xcel is limited to 17 casks on the concrete pad by Minnesota Statute § 116C.771. The 17 casks hold 40 storage spaces each, for a total of 680 storage spaces. However, if that statute were changed, Xcel would require about 11 more casks to run the plant to the end of its current license life in 2013-2014. Each cask costs about $2.1 million, for a total of $23.1 million for the 11 casks.[14] The concrete pad was designed to hold 48 casks, and was licensed by NRC to hold 48 casks. Thus, further NRC approval would not be necessary.

As a side note, the 1994 Prairie Island legislation—1994 Session Laws, Chapter 641, S.F. 1706—required Xcel to examine the potential for a short-term storage installation, in Goodhue County, but not on the Prairie Island site. No storage facility resulted from this process.

19. Could these short-term storage sites be made into long-term storage sites?

This outcome is unlikely and would be highly controversial. By an act of Congress, only the federal government can legally dispose of used nuclear reactor fuel in the long-term. Therefore, choosing to keep the waste permanently in the state would require that we build or improve the existing facilities and acquire additional licenses from the NRC. In essence, Minnesota would have to volunteer to replace Yucca Mountain. The long-term storage licensing process and construction process would take several years; Yucca Mountain has been studied since at least 1983 and is still not ready. Furthermore,

[13] The cost number comes from Xcel's 2000 resource plan proceeding.
[14] Data taken from Xcel's 1999 Review of Remaining Lives, made February 12, 1999. A per cask cost of $2.1 million represents the cost of the last 10 casks (#8 to #17).

Minnesota Statute § 116C.72 states that no person shall construct or operate a radioactive waste management facility within Minnesota unless expressly authorized by the Minnesota Legislature. Thus, legislative permission would have to be obtained in addition to federal permits.

20. What happens if no additional storage is granted?

Without added storage, Prairie Island would have to shut down in 2007, several years before the NRC reactor licenses expire on August 9, 2013 for Unit 1 and October 29, 2014 for Unit 2.[15] Since Prairie Island has two reactors it has two licenses from the NRC.

If Prairie Island were to shut down in 2007, two main events would be triggered. First, replacement power would have to be acquired. Second, the Prairie Island site would have to be decommissioned.

21. How would Prairie Island be replaced?

The power produced by Prairie Island would be replaced via a "contingent bidding" process established by the PUC. The winning bidder is scheduled to sign a purchased power agreement (PPA) with Xcel during the spring of 2002. The PPA would determine the total cost. Since actually using the PPA will be contingent on Prairie Island not being available, each PPA bid has a schedule of termination fees, to cover the permitting and construction costs incurred by the bidder even if Xcel decides to terminate the PPA before starting to receive power in 2007. Xcel would terminate the PPA early if Prairie Island is not shut down.

Since Prairie Island is a base load plant operating 24 hours a day, 7 days a week, the bids should likely be for baseload plants too. Most baseload plants in Minnesota are coal-fired. However, natural gas can also be used to fuel a baseload plant but is likely to be more costly than coal to operate. One reason for the increased cost is because all natural gas is piped in to Minnesota and a new transportation pipeline may be necessary, along with a branch line, before a natural gas-fueled power plant could be built, depending on the site. Most other technologies are unlikely to win the bidding process. For example, a nuclear plant would face storage problems similar to those of Prairie Island and wind is an intermittent resource; it is not available all the time. Ultimately, the bidding process will ensure that the most cost-effective replacement will be procured.

22. What bids were received?

Several bids were received and the "short list" has been announced. The short list contains three "half-sized" baseload facilities and two "full-sized" baseload facilities. The most likely scenario is that either two "half-sized" facilities or one "full-sized"

[15] As a side note, Monticello's license expires September 8, 2010.

facility will be selected to replace Prairie Island. The public information on bids is shown in Table 3.

Table 3: Prairie Island Short List

Company	Size	Technology	Site
Aquila	585 MW	Natural Gas Combined Cycle	Missouri
Calpine-Mankato	565 MW	Natural Gas Combined Cycle	Mankato
LS Power	550 MW	Coal	Rosemount
Calpine-Welch	998 MW	Natural Gas Combined Cycle	Red Wing
Nordic Energy	1,100 MW	Coal-Fired Integrated Gasfication Combined Cycle	Rosemount

This process remains relatively on-track. That means a winning bidder(s) may be announced in December 2002 or soon thereafter with a PPA to be signed during spring 2003.

23. What is the cost to replace Prairie Island?

Table 4 provides some rough estimates of the cost to construct a replacement to Prairie Island's 1,070 MW of capacity. The capital cost would be, roughly, between $690 and $925 million. These costs do not include costs of operating the plants.

Table 4: Illustrative Costs to Construct Replacement Power

Type	Capital Costs Per kW	Prairie Island Total kW	Total Capital Cost
Natural Gas	$645	1,070,000	$690,150,000
Coal	$863	1,070,000	$923,410,000

Note that these costs are only illustrative. The PPA that is signed by Xcel with the winning bidder would determine the actual cost.

24. How do you take apart a nuclear plant?

The process of taking apart a nuclear power plant so that the land can be returned to other uses is called decommissioning. There are three strategies for doing this. In a DECON strategy, the power plant is taken apart and the site decontaminated as soon as possible. For Prairie Island this process would take about 3 years for planning, 9 years for decommissioning, and 2 years for site restoration; about 14 years total.

A second strategy is SAFSTOR where the power plant is "mothballed" for a period of time and then taken apart at a later date. During SAFSTOR, a facility is left intact, but the fuel has been removed from the reactor vessel and radioactive liquids have been drained from systems. Radioactive decay occurs during the SAFSTOR period, thus reducing the levels of radioactivity in and on the material and potentially the quantity of material that must be disposed of during decontamination and dismantlement.

The third strategy is ENTOMB, where a sarcophagus is built around the power plant. Because most reactors will exceed the radiation limits even after 100 years, NRC views this option as generally not feasible. However, this option might be acceptable to the NRC for reactors that can demonstrate that radiation levels will decay to unrestricted use levels in about 100 years.

In past reports to the PUC, Xcel has indicated a preference for a DECON strategy. In order to use DECON, additional dry storage casks would have to be granted by the PUC, as allowed under Minnesota Statute § 116C.771. However, additional spent fuel handling facilities may be required at the dry cask storage site since the power plant and its associated facilities would be dismantled during DECON decommissioning.

25. What would decommissioning cost?

The most recent cost estimate for decommissioning was performed in 2002 and was provided for a variety of scenarios.[16] There are several variables that can affect the cost of decommissioning. Three important variables are the decommissioning method, the operating life of Prairie Island, and the inflation rate for the cost of decommissioning activities. Based on Xcel's highest inflation rate (4 percent), the Department calculated the present value of the costs under a variety of potential scenarios. The purpose of these calculations is to illustrate the impact resulting from various policy choices. Table 5 below provides these estimated costs. In Table 5 the rows represent decommissioning methods and the columns represent the operating life of Prairie Island.[17]

Table 5: Present Value of System-Wide Decommissioning Costs

Method	PI to 2007 A	PI to 2013/14 B	Difference A - B
1 Safstor	$827,555,720	$728,817,881	$ 98,737,839
2 Decon	$732,414,227	$638,389,955	$ 94,024,272
1 - 2 Difference	$ 95,141,493	$ 90,427,926	

The necessary funds, based on a DECON strategy and a 2007 shut down date (option A2 above), are currently being collected from ratepayers. These funds are being set aside in external accounts with a target date of 2007 for fully funding Prairie Island's decommissioning. Monticello's decommissioning, also based on a DECON strategy, should be fully funded (in external accounts) in 2010, the year its license expires.[18]

26. Does continued operation of Prairie Island require anything but more storage?

[16] See Xcel's October 11, 2002 filing in Docket No. E002/M-02-1766.
[17] The Department notes that legislative action extending Prairie Island's operating life would have an impact on Xcel's accounting for Prairie Island's decommissioning costs. Those impacts would be addressed by the Public Utilities Commission subsequent to the legislative action.
[18] Some of the funds set aside in the past are currently held in internal accounts but are being shifted to external accounts.

Prairie Island is having problems with its steam generators. In the steam generators, heat is transferred between loops. The heat is transferred when water from one loop (which comes from the reactor) passes by tubes from a second loop. These tubes are showing signs of corrosion, which is becoming common in steam generators similar to those at Prairie Island. In response to the corrosion tubes are plugged. By 2001 about 8 percent of the tubes were plugged in Unit 1. When plugging reaches 10 percent more inspections are needed and energy output is decreased. Unit 2 is also experiencing corrosion, but at a lower rate.

Originally, Xcel began the preliminary work needed so that the steam generators could be replaced as early as 2004. According to a the most recent engineering study, Prairie Island Unit 1 could shut down as early as 2009 due to declining performance. However, the Public Utilities Commission warned Xcel that it did not support replacing steam generators without additional storage since it would not be cost effective to replace the generators if the plants shut down in 2007.

27. Could you summarize the ratepayer impact of all these issues?

In 2001, the Department performed modeling of ratepayer impacts resulting from the policy choices regarding Prairie Island. This modeling indicated that, compared to shutting down at the end of 2007, extending Prairie Island to the 2013 would result in $0.54 billion of avoided costs; that equals about $4.09 annually for 20 years for a residential customer. Extending Prairie Island through 2033 would result in $2.38 billion of avoided costs; that equals about $6.57 annually for 50 years for a residential customer. The Department did not perform any modeling regarding the Monticello plant.

At this time actual bids to replace Prairie Island have been received. Xcel's most recent resource plan used these bids to provide information regarding the impacts of policy choices regarding the operating lives of the Company's nuclear plants.[19] Table 6 below summarizes the results of the Company's analysis.

Table 6: Present Value of Societal Costs

Societal Avoided Costs by Scenario			
Scenario	Low	High	Midpoint
M '30 & PI '33	$ 1,775	$ 3,125	$ 2,450
Monti to '30	$ 625	$ 950	$ 788
PI to '33	$ 1,150	$ 2,175	$ 1,663
PI to '13	$ 75	$ 775	$ 425

The results obtained by the Department in 2001 and Xcel in 2002 can be compared in a rough manner. First, both sets of results agree that extending the production life of Prairie Island from 2007 to 2013 will result in $450-$500 million of avoided costs. Second, regarding running Prairie Island through a license extension (2033) the

[19] See page 102 of the Company's December 2, 2002 filing in Docket No. E002/RP-02-2065.

Department's 2001 estimate of avoided costs exceeds the upper bound of Xcel's range by about $150 million. Xcel's estimates are likely to be more accurate because they are based upon the actual replacement bids rather than generic replacement plants.

28. How did Xcel gain dry-cask storage at Prairie Island?

In 1991 Xcel applied for a Certificate of Need (CN) for 48 casks and a concrete pad on which to store them. During the resulting hearings, the Department argued for a CN limited to 14 casks. The Administrative Law Judge (ALJ) recommended rejecting the CN entirely based on the conclusion that it would become permanent. If the site was permanent, Minnesota Statutes §§ 116C.72 and 116C.71, subd. 7 would require legislative approval. On August 10, 1992 the PUC rejected the ALJ's recommendation, concluding that the facility would not be permanent. The PUC approved a CN limited to 17 casks. The PUC subsequently denied reconsideration of its decision on September 3, 1992.

The Prairie Island Mdewakanton Dakota Community and others then filed petitions for a *writ of certiorari*. As a result, on May 28, 1993, the Minnesota Court of Appeals decided that legislative approval was necessary since the facility was properly classified as one in which waste is permanently stored. Thus, the issue was moved from the PUC, then to the courts, and finally to the Legislature. In 1994 the Minnesota Legislature passed a bill granting Xcel storage as outlined in the PUC's CN.

29. What was the 1994 legislation on Prairie Island?

In 1994 the Minnesota Legislature passed legislation that ratified the Environmental Impact Statement approved by the Environmental Quality Board and the Limited Certificate of Need granted by the PUC. It was estimated at the time that this provision gave Xcel enough storage to last until 2001. However, Xcel subsequently re-engineered the fuel cycle and made more efficient use of the temporary racks to extend Prairie Island's life until 2007.

The core of the 1994 legislation gave Xcel additional storage and in exchange limited Xcel's ability to re-rack the storage pool or use additional casks, (except for decommissioning purposes) and required Xcel to spend money on renewable energy and other matters (see below for list).

The legislation had some generically applicable parts such as:

- preventing the Public Utilities Commission from granting a Certificate of Need for a new nuclear power plant,
- requiring a recording of all proceedings before the PUC,
- preventing the PUC from approving advertising to promote nuclear power or nuclear storage, and
- establishing the Legislative Electric Energy Task Force (LEETF).

In addition, the legislation required Xcel to:

- spend an extra 0.5 percent of gross operating revenues on conservation ($8.5 million in 2002; $9.1 million in 2003),
- acquire 425 MW of wind generated power by the end of 2002,
- acquire 400 MW of wind generated power if the PUC found it met least-cost planning criteria (the PUC subsequently ordered Xcel to obtain the 400 MW through all-source bids),
- acquire 125 MW of closed-loop biomass generated power,
- provide a 50 percent discount on the first 300 kWh of electricity used by low-income customers, (estimated cost $4.4 million per year).
- place $500,000 per cask per year into a renewables development fund starting in 1999 (paid $25.0 million through 2002), and
- investigate the potential for an off-site storage facility in Goodhue County.

30. Does the local Tribe have any special rights?

Before the authorization for additional casks could have force, Minnesota Statute § 116C.773 required the State of Minnesota and Xcel to enter into an agreement binding the parties to the terms of Minnesota Statutes §§ 116C.771 and 116C.772, as well as the mandates for 200 megawatts of wind power and 75 megawatts of biomass required by Minnesota Statutes §§ 216B.2423, subd. 1 and 216B.2424.[20] Furthermore, the legislature specifically declared the Mdewakanton Dakota Tribal Council at Prairie Island (Tribal Council) as an intended third-party beneficiary of the agreement with standing to enforce the terms of the agreement. See Minnesota Statute § 116C.773.

On May 19, 1994, the State of Minnesota and Northern States Power Company (now Xcel) entered into a contractual agreement continuing the terms required by Minnesota Statute § 116C.773 (agreement). The agreement also included mention of the Tribal Council as an intended third-party beneficiary with standing to enforce the terms of the agreement. A copy of the agreement is included as Attachment 4.

As signatories to the agreement, both Xcel and the State may enforce the terms of the agreement, including the requirements set forth in relevant statutes and rules, i.e., Minn. Stats. §§ 116C.771, 116C.772, 216B.2423, subd. 1 and 216B.2424. Similarly, while the Tribal Council is not a signatory to the agreement, it has a statutory and contractual right to standing that may include the right to intervene in cases and appeal agency orders involving the terms of the agreement, the requirements set forth in the above-mentioned statutes, as well as any other statutes and rules where standing can be demonstrated.[21] Thus, if the Legislature were to alter or repeal Minnesota Statute §

[20] These laws required an additional 225 MW of wind and 50 MW of biomass, but the agreement did not include these requirements.

[21] The Minnesota Supreme Court has adopted the "intended beneficiary" approach outlined in Restatement (Second) of Contracts § 302 (1979). See Cretex Cos. V. Construction Leaders, Inc., 342 N.W.2d 135, 139 (Minn. 1984). Under this approach, a third party can recover on the contract if shown to be an "intended beneficiary" under either the "intent to benefit" or the "duty owed" test. The "intent to

116C.773 or any of the statutes or terms found in the agreement, we can anticipate participation at the Legislature by Xcel, the State and the Tribal Council at a minimum.

31. What is the history of the spent fuel pool?

Construction of the Prairie Island plant began in 1968 with commercial operation beginning in 1973 and 1974. At that time, the spent fuel pool could hold about 200 slots.[22] The pool was so small because it only needed to hold the spent fuel until it was shipped out for reprocessing into new fuel. When it became clear that reprocessing would be delayed, Xcel took action to expand the pool in 1977 and 1981. The 1977 expansion increased pool capacity to 687 slots (555 normal slots plus 132 removable slots) and the 1981 expansion increased pool capacity to 1,582 (1,386 normal slots plus 196 removable slots). The pool has not been substantially modified since. Only the 1981 expansion was subject to a CN, then under the Minnesota Energy Agency. That CN was granted on February 3, 1981.

32. Why hasn't Monticello experienced similar storage problems?

Monticello shipped some of its spent fuel to a storage pool in Morris, Illinois. The Morris site is operated by General Electric Company (GE). Enough fuel was shipped off-site to allow Monticello to operate to the end of its license in 2010. The fuel was shipped to GE's Morris facility under a specific contract. GE signed contracts with utilities in which GE agreed to accept spent fuel. GE's facility is essentially full and, according to the NRC, has no plans to accept additional fuel.

33. Does Xcel have any other nuclear power plants?

Xcel does not have any operating nuclear power plants other than Prairie Island and Monticello at this time. However, Xcel owned Pathfinder, a 66-megawatt nuclear power plant that was built and operated from 1963 to 1967 by Xcel. Pathfinder was located near Sioux Falls, SD. Apparently due to operational problems the plant was placed in protective storage in 1967 and converted to a fossil fuel-fired power plant. The plant's nuclear facilities were decommissioned between 1990 and 1992; the plant's fossil fuel-fired boilers continue to operate.

In addition to planning, funding and managing the decommissioning of Pathfinder, Xcel did most of the decommissioning work with its own staff. Where Xcel lacked the expertise or resource—in heavy lift rigging or rail transportation, for instance—it hired

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benefit" test calls for a contract expressing some intent by the parties to benefit the third party through contractual performance. The "duty owed" test calls for a contract demonstrating that the promisor's performance discharges a duty otherwise owed the third party by the promisee. Under this approach, if recognition of third-party beneficiary rights is "appropriate" and either the duty owed or the intent to benefit test is met, the third party can recover as an "intended beneficiary."

[22] The exact amount is not clear; the 1981 CN proceedings indicate 210 slots and the 1991 CN proceedings indicate 198 slots.

outside help. The plant's used nuclear fuel had been shipped off-site in the late 1960s, so Xcel was only concerned with removing low-level radioactive waste.

In addition to Pathfinder, Xcel and three partners proposed to build another nuclear plant, called Tyrone, in Wisconsin. NRC records indicate this was to be a 2-unit reactor with each unit to produce 1,150 MW. The proposal to build Tyrone was rejected by the Wisconsin Public Service Commission on March 6, 1979, only 22 days before the accident at Three Mile Island. Since the unit was never built and proposed for Wisconsin, the Department could not locate any records regarding Tyrone.

34. What is the Nuclear Management Company?

Nuclear Management Company (NMC) was formed in 1999 by four utilities (including Xcel) to operate their seven nuclear generators, located in Minnesota, Iowa, and Wisconsin. The goal of NMC is to improve the safety, reliability, and operational performance of the power plants. NMC hopes to achieve this goal through sharing best practices and by having the utilities transfer day-to-day operating responsibility to NMC. NMC also hopes that the larger company, with more power plants, will enable NMC to retain its employees.