3 Proposed Project

The project is proposed to be located at up to 24 sites in Benton, Blue Earth, Carver, Chippewa, Chisago, Dodge, Goodhue, Kandiyohi, Le Sueur, McLeod, Pipestone, Rice, Stearns, Waseca, Washington, and Wright counties. Figure 1 illustrates the proposed facility locations. Figures depicting each facility are found in Chapter 6 and more detailed depictions of preliminary design for each facility if found in Appendix D.

3.1 Project Components

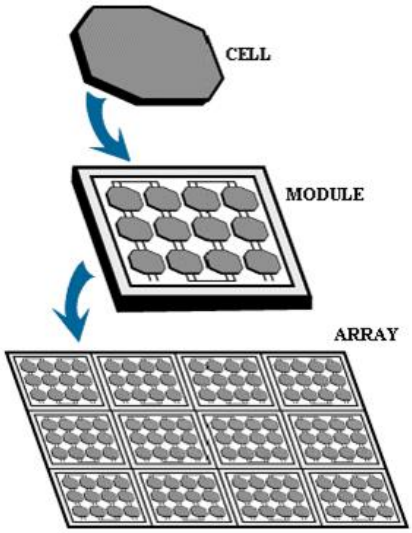
Each facility will be comprised of PV modules mounted on linear axis tracking systems and centralized inverters. In addition to the modules grouped into arrays, each facility will also include electrical cables and conduit, electrical cabinets, step-up transformers, SCADA systems and metering equipment, an operations and maintenance (O&M) area, and roads providing access to the equipment. A perimeter fence will surround the project components with access to the facility through a central gate.

3.1.1 PV Arrays

Each facility will include PV modules of 4 to 6.5 feet long and 2 to 3.5 feet wide mounted on a linear single-axis tracking system. The modules will be grouped into arrays.

While there are different technological variations, the most common PV cells consist of a specially treated conductor made up of two layers with relative positive and negative charges. This conductor is between two contacts that are connected to an external load. Individual PV cells can be combined as a module or solar panel to generate greater quantities of electricity. Grouped solar panels are referred to as a solar array. This progression is depicted in Figure 2.

Figure 2: PV Array[13]

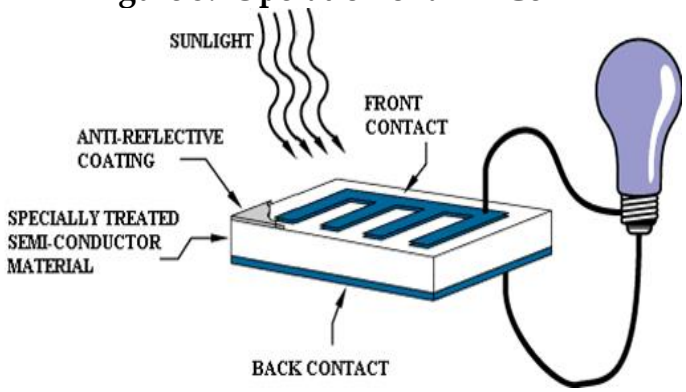


PV systems convert both direct and indirect solar energy (direct and scattered sunlight) to electrical energy by capitalizing on nature's inherent desire to keep electrical charges in balance.[14] At the most basic level, electrical current is the flow of electrons through a conductor. When solar radiation strikes a PV cell some of it is absorbed exciting electrons within the cell. Some of these electrons move freely between layers from negative to positive. In the process, electrons from the positive layer are disrupted and "flow" back to the negative layer through the external load creating a continuous flow of electrons, or, a continuous flow of electric current as depicted in Figure 3.

[13] National Aeronautics and Space Administration. 2011. *How Do Photovoltaics Work?* http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells/

[14] US Department of Energy, Office of Energy Efficiency and Renewable Energy. 2013. *Photovoltaic Technology Basics*. http://energy.gov/eere/energybasics/articles/photovoltaic-technology-basics; National Aeronautics and Space Administration, 2011

Figure 3: Operation of a PV Cell[15]



PV systems can be configured as a "fixed" or "tracking" system. Permanently mounted in a stationary position, fixed systems are aligned to gather the greatest level of solar radiation over the course of the year. These systems are often subject to site-specific constraints, e.g., roof angle, which limit their overall efficiency.

The Project will use a single axis tracking system to allow the panels to track the sun across the sky. While more expensive than fixed-tilt systems, tracking systems can increase system efficiencies by as much as 33%.[16] There are two general types of tracking systems: single axis and dual axis. Single axis systems track the sun from east to west throughout the day. Dual axis systems track the sun both east to west throughout the day and north to south throughout the year.

The panel blocks will be mounted on metal racks that will be installed on a series of posts driven into the soil. Aurora anticipates that most, if not all of the tracking system foundations will be driven directly into the soil. In some cases the results from geotech soil tests may dictate concrete foundations be used. Each panel block contains internal access drives and electrical utilities to support the array. Power production circuits are separated from the tracking circuits, allowing the PV modules to operate during an unscheduled outage of the tracker system.

3.1.2 Roads

Within each facility earthen or gravel roads, typically 12 to 20 feet in width, will be constructed to provide access to the facility equipment for maintenance and, when necessary, emergency vehicles. Road configuration is dependent upon final design: preliminary road configuration is depicted in the preliminary facility layout drawings show in Appendix D.

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[15] National Aeronautics and Space Administration, 2011
[16] Appleyard, D. *Solar Trackers: Facing the Sun*. 2009. http://www.renewableenergyworld.com/rea/news/article/2009/06/solar-trackers-facing-the-sun

Each facility will be accessed from the public road network; some are through existing drives, others will require the establishment of a new access point. Anticipated access plans are described in each facility description in Section 6. Other than the establishment of new facility access or improvements to existing access points, no upgrades or changes to existing roadway systems are necessary for construction or operation of the Project.[17]

3.1.3 Electrical System

PV cells generate direct current (DC) electricity, which must be converted to alternating current (AC) electricity to be utilized on the electrical grid. This is done by an inverter. The electric cabling used to deliver the DC power from the panels to the inverters will typically be located in an underground trench (approximately three feet deep and one to two feet wide) or, in some limited circumstances aboveground conduit.

The final number of inverters for each facility is dependent upon the inverter size, inverter and panel availability as well as the final facility design. Aurora anticipates that each panel block will require one to four inverters, depending on the size of the panel block. Inverters will be installed adjacent to the panel blocks on an inverter skid or on a concrete pad, either of which may be enclosed. Depending upon final equipment selection, each inverter would be approximately 10 to 12 feet tall and the equipment enclosure, if used, will be up to approximately 45 feet long by 10 feet wide by 10 feet tall. After the inverter has converted the electricity to AC, a transformer steps up the electricity from low-voltage to medium voltage (up to 34.5 kilovolts [kV]). Each inverter pad will also include one or more transformers to which the inverters will feed electricity.

The electricity will be taken from the facility into the electrical grid via a gen-tie line. Xcel Energy determines the location of the point of interconnection (POI) where the Aurora facility infrastructure meets the Xcel Energy infrastructure at each facility. The POI will be within Aurora's area of site control, typically within the fenceline surrounding the facility components, although in some cases the POI may be outside the fenceline while still within the area of site control. Aurora is responsible for all equipment on the facility side of the POI. Xcel Energy is responsible for designing the infrastructure needed on the utility side between each Aurora facility and the local Xcel Energy substation. Xcel Energy is also responsible for permitting, constructing, operating and maintaining the infrastructure on the utility side of the POI.

Aurora has not yet received detailed design information from Xcel Energy on any electrical connections. At this time Aurora anticipates that the gen-tie line will be built underground to the point of interconnection (POI) with Xcel Energy. However, in some limited circumstances there may be a utility overhead extension at the dead end of the gen-tie line.

[17] Aurora, *Aurora Distributed Solar Project Application for a Site Permit*. July 7, 2014, eDocket ID, 20147-101312-02 (Hereinafter, "Application"), at p. 25

3.1.4 Operations and Maintenance Area

Aurora may establish an Operations and Maintenance (O&M) area at each facility, or may consolidate maintenance activities at one facility to serve multiple facilities in an area. An offsite centralized warehouse may also be used to house strategic spare parts. Once array installation is complete, the primary staging area will be reduced in size to accommodate the O&M area. Design of the O&M area may differ somewhat between facilities. All O&M areas will have a flat gravel or grass area for parking and receiving. Some facilities may also include a pre-engineered metal container or shed for material storage. These structures are anticipated to be approximately 10 feet by 20 feet and 17 feet high at its peak. Aurora may install a well and septic system at some, but not all O&M facilities.

Aurora may install an above-ground storage tank at one or more facilities to store fuel for maintenance equipment.

Lights will be installed on temporary 18-foot service poles to provide lighting during the construction phase of the Project. After construction the temporary service poles will be removed and permanent motion-activated lighting will be installed near O&M areas, security gates and in perimeter areas. Lighting will be downlit to minimize impacts to adjacent land uses.

3.2 Project Construction

Aurora anticipates that construction of some facilities may begin in late 2015, with all facilities online by the end of 2016. Aurora estimates that construction at each facility will last approximately four to eight months,[18] with construction of the entire Project lasting approximately one year.[19] Construction duration at each facility is largely a function of the facility size and coordination between facilities (Table 5).

Table 5: Construction Timeline for Individual Facilities[20]

Task	Duration	Key Predecessor
Site preparation, grubbing and clearing	2 days per acre	Construction begins
Laydown area and temporary job site trailers established	7 days	Construction begins
Civil construction	10 days per acre (may vary according to terrain)	Laydown area and temporary job site trailers established
PV mounting posts	5 days/MW	Site preparation, grubbing and clearing
Underground collection system	4 days/MW	Site preparation, grubbing and clearing

[18] Application, at p. 26
[19] Application, at p. 8
[20] Application, at p. 28

Task	Duration	Key Predecessor
Electrical enclosure/inverter	15 days/unit	Laydown area and temporary job site trailers established
Tracker installation	3 days/MW	PV mounting posts
PV module installation	3 days/MW	Tracker installation
Interconnection tie within facility boundary	10 days/facility	Laydown area and temporary job site trailers established
Testing	20 days/facility	Interconnection tie

3.2.1 Site Preparation

Once necessary permits are obtained, Aurora will begin preparing the facility location for construction. Once access to the site is established, woody vegetation will be cleared in areas where the PV installations and roads will be constructed. Additional site preparation tasks include establishment or improvement of access to the site, grading in some areas of the site to establish a level area for installation of the PV equipment, and establishment of a staging/laydown area.[21] Aurora estimates that the site preparation, including grubbing and clearing, will last approximately two days per acre, or up to approximately 50 days, depending upon the site.[22]

In order to provide a level surface for solar arrays Aurora anticipates grading at 20 of the facilities: Albany, Annandale, Atwater, Chisago, Dodge Center, Fiesta City, Lake Emily, Lake Pulaski, Lawrence Creek, Lester Prairie, Mayhew Lake, Montrose, Paynesville, Scandia, Waseca, West Faribault, Waconia, Wyoming and Zumbrota. Grading areas range from zero (no grading) to 62.8 acres per facility; acreages by site are discussed in Section 6 and shown in the figures for each facility in Section 6 and in Appendix D.

The intent of the grading is to establish a relatively uniform surface to accommodate the single axis tracking systems. The preliminary determination of areas to be graded at each facility was determined through assessment of the current grade, the direction of the grade and the desire to maximize useable space for the solar arrays. To the extent feasible, Aurora will design the facilities to ensure that the surface does not face north in order to maximize power production yields.[23]

The proposed grading process would include both cut and fill activities. Higher areas would be excavated (cut) and the material used to raise the surface (fill) of nearby lower areas. Aurora will attempt to design the site so as not to require either the import or export of earthen materials. Aurora anticipates spreading any excess soils across the facility or, if necessary, exporting cut materials to an offsite location in accordance with local regulations.

[21] Application, at p. 25
[22] Aurora, Response to EERA Environmental Review Question 2b, December 4, 2014 (Appendix C).
[23] Aurora, Aurora, Response to EERA Environmental Review Question 14, January 16, 2014 (Appendix C)

Aurora does not anticipate the use of general fill during construction, but may import structural fill at some facilities for roadways or, in limited cases, foundations.[24]

Early in the construction process a staging and laydown area will be established within the facility boundary. The staging area will be used to receive and store delivery of construction materials and may house a temporary onsite construction office. In some cases, a central laydown area may serve a group of facilities.[25]

3.2.2 Construction of Solar Energy System and Ancillary Facilities

Following site preparation, solar arrays will be constructed in blocks ranging in size from 0.5 MW to 2.0 MW in rated nameplate capacity. Access roads will be constructed between the blocks. The size of the blocks will be dependent upon inverter and racking equipment specifications. Aurora anticipates that a typical block will be between 500 kW and 2 MW of nameplate capacity, ranging in size between 3 and 14 acres.[26]

PV panels will be installed on a single-axis tracking system. Aurora anticipates that the majority of the tracking system foundations will be a driven pier, although soil conditions at some locations may require that the tracking systems be installed in concrete foundations.

Typical construction equipment such as scrapers, dozers, dump trucks, watering trucks, motor graders, vibratory compactors, and backhoes will be used during construction. Specialty construction equipment that may be used during construction will include:

- Skid steer loader;
- Vibratory pile driver;
- Medium duty crane;
- All-terrain forklift;
- Concrete truck and boom truck;
- High reach bucket truck; and
- Truck-mounted auger or drill rig.

Aurora will use Best Management Practices (BMPs) to limit erosion and soil compaction, during construction. Disturbance will occur during the normal course of work, which can take several weeks in any one location. As construction is completed, Aurora will restore and re-vegetate disturbed areas.

[24] Aurora, Aurora, Response to EERA Environmental Review Question Q16, January 6, 2015 (Appendix C)
[25] Application at p. 26
[26] SPA at p. xx; Aurora, Aurora, Response to EERA Environmental Review Question 5a (Appendix C)

3.3 Post-Construction Restoration

As construction is completed on each facility, areas disturbed during construction will be restored. Temporary staging and laydown areas will be vacated and any temporary roads will be decommissioned and restored. The site will be graded to its natural contours, access roads will be re-graded, filled and dresses as needed. Any post-construction erosion control methods specific to the site will be implemented consistent with permits and contractor specifications. Soil compacted during construction will be loosened if necessary and disturbed areas will be reseeded and re-vegetated consistent with a project-specific re-vegetation and restoration plan. With the exception of access roads, all areas disturbed during construction will be re-vegetated with a weed-free, low-growing seed mix (e.g., clover, short grasses or flowers, low-growing forbs, low-growing wetland seed mixes or some other low-growing perennial cover). Aurora anticipates that the post-construction clean-up and site restoration activities will last approximately two to four weeks per facility.

3.4 Project Operation and Maintenance

The expected service life of the proposed facilities is 25 to 40 years.[27] The generating facilities will be remotely operated through a real-time control system for most operations functions. All monitored data will be managed by Aurora or contracted out to a qualified subcontractor. Onsite operation will be performed from time to time as required for certain resets and troubleshooting activities. Operations personnel will monitor the performance of the Project facilities through a regular (weekly or monthly) review of data from each facility's onsite meteorological station (energy produced, alarms, faults, etc.).

Aurora estimates that the Project will require up to 19 full-time permanent equivalent positions to operate and maintain the facilities. O&M offices will not be located at all facility locations; rather the staff will visit the facilities on a regular basis.

All maintenance activities will be performed by qualified personnel. Regular maintenance of the Project facilities will include scheduled equipment inspections, road maintenance, vegetation maintenance including mowing the ground cover that is planted under the arrays at each facility, fence and gate inspection, lighting system checks, and PV panel washing as necessary (minimal to no washing is anticipated to be needed at Project facilities). Regular inspection for facility components will include inspection of:

- PV panels: visual examination of the panels and tracking system and surrounding grounds to verify panel and tracking integrity;
- Inverters, transformer and electrical panels: visual inspection of the devices including connection cabinets and the grounding network, check for presence of water and dust;

[2727] SPA, at p. 29

- Electrical inspection: measurement of insulation level and dispersion, inspection of main switches and safety devices (fuses);
- Cabling and wiring: visual inspection of buried and overhead electrical line and connection box to verify integrity; and
- General facility inspection: visual inspection for the presence of animals, integrity of the fencing, nests, noise check for abnormal sounds.

Aurora will create a maintenance plan for the Project to ensure continued performance of the solar facilities. The plan will include scheduled inspection of the major components and a scheduled maintenance cycle that incorporates the degradation or loss of efficiency (also referred to as derating/degradation) of the components that is expected over time. Once construction is complete, the individual solar facilities will see one to two trucks on site periodically, at intervals associated with the maintenance schedule during normal operations (Table 6).

Table 6: Operations and Maintenance Tasks and Frequency[28]

Component and Task	Anticipated Frequency
Photovoltaic Field	
PV modules visual check	Every two months
Wirings and junction boxes visual check	Quarterly
PV strings measurement of the insulation	Quarterly
PV strings and string boxes faults	Weekly
PV panels washing	No regular washing planned, (only as site-specific conditions warrant)
Grass cutting (if necessary at site)	Once in Spring, once in Summer
Electric boards	
Case visual check	Twice Yearly
Fuses check	Twice Yearly
Surge arresters check	Twice Yearly
Torque check	Twice Yearly
DC voltage and current check	Twice Yearly
Grounding check	Twice Yearly
Inverter	
Case visual inspection	Every two months
Air intake and filters inspections	Every two months
Conversion stop for lack of voltage	Twice Yearly
AC voltage and current check	Twice Yearly
Conversion efficiency inspection	Twice Yearly
Datalogger memory download	Twice Yearly
Fuses check	Twice Yearly
Grounding Check	Twice Yearly
Torque check	Twice Yearly
Support Structures	
Visual check	Twice Yearly
PV module torque check on random sample	Twice Yearly

[28] SPA, p. 31

3.5 Project Costs

Aurora has estimated that the installation of the Aurora Project as proposed will cost approximately $247 million, or $2.47 million per MW AC. Once operational, Aurora anticipates annual operating costs to be in the range of $45,000 to $60,000 per MW AC, or $4.5 to $6.0 million.[29] Operating costs include labor, materials, and property taxes.[30]

3.6 Decommissioning and Repowering

Aurora anticipates the useful life of each facility will be approximately 25 to 40 years.[31] Aurora's determination of a facility's useful life is influenced by energy market conditions, regulations, anticipated equipment lifetime, highest and best use of the underlying property and ongoing operations costs.[32]

The equipment itself can typically continue to function up to 40 years or more. Panels, for example may produce energy for several decades past the initial 20-year power purchase agreement. The useful life will ultimately be determined by the economics of the project that take into account the factors listed above.

At the end of the Project's useful life Aurora will determine whether to decommission each facility, consistent with the terms of the Site Permit, or to seek repowering of the facility. Aurora will consider a number of criteria in deciding whether or not to decommission or extend/repower a facility include the following:[33]

- Extension of an existing power purchase agreement or the execution of a new power purchase agreement. The decision on whether to extend the power purchase agreement considers the local energy demand and the cost of electricity from other generation sources;
- The cost to repower and generate the electricity, including the cost to repair or replace non-power producing equipment such as racking and foundations;
- The cost to decommission;
- The opportunity cost to utilize the land differently (best and highest use of the land);
- Regulations; and
- On-going maintenance and operational costs.

Section 10 of the Site Permit Template requires that Aurora prepare a *Decommissioning* Plan prior to operation of the Project. The *Decommissioning Plan* should document Aurora's

[29] Application, at p. 19; Appendix C
[30] Application, at p. 19
[31] Application, at p. 29
[32] Appendix C
[33] Appendix C

plan for decommissioning of the Project and restoration of the site, estimated cost of decommissioning, and a description of how Aurora will ensure that the financial funds necessary to decommission the Project are available.

Aurora estimates that decommissioning tasks will take two to three weeks per facility to complete. After removal components will be examined and either recycled or disposed of appropriately. Aurora has provided the following breakdown of decommissioning tasks:

- Modules are inspected for physical damage, tested for functionality, and removed from racking. Functioning modules are packed and stored for reuse (functioning modules may produce power for another 25 years or more). Non-functioning modules are packed and palletized and sent to the manufacturer or a third party for recycling or other appropriate disposal method;
- Racking is uninstalled, sorted, and sent to metal recycling facility;
- Steel poles removed and sent to a recycling facility. Post holes are backfilled;
- Aboveground wire is sent to facility for proper disposal and recycling. Belowground wire is abandoned in place at depths greater than four feet;
- Aboveground conduit is disassembled onsite and sent to recycling facility;
- Junction boxes, combiner boxes, external disconnect boxes, etc., are sent to electronics recycler;
- Inverter is sent to manufacturer and/or electronics recycler. Functioning parts can be reused. Holes are filled;
- Concrete pad(s) are sent to concrete recycler. Holes are filled;
- Fence is sent to metal recycling facility;
- Computers, monitors, hard drives, and other components are sent to electronics recycler; and
- Functioning parts can be reused.

After all equipment is removed, the facility will be restored. Holes created by poles, concrete pads, and other equipment will be filled in with soil to existing conditions and seeded.

Aurora plans to establish an escrow account with the landowner to cover the costs of decommissioning each facility. The facility lease provides for an escrow account to secure Aurora's obligations to remove the facilities upon the end of the PV system's useful life or at the end of the lease term. Under the conditions of the lease, the escrow shall be held, administered, and disbursed by a qualified escrow agent mutually agreeable to the parties, such as a title company or bank.[34]

[34] Application, at pp. 32-33