JPL 5103-55

Thermal Power Systems
Small Power Systems Applications Project

Regulations Applicable to Solar Thermal Power Plants: Interim Report

March 15, 1979

Prepared for
U.S. Department of Energy
by

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

5103-55

Thermal Power Systems
Small Power Systems Applications Project

Regulations Applicable to Solar Thermal Power Plants: Interim Report

S. Ireland

March 15, 1979

Prepared for
U.S. Department of Energy
by
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Prepared by the Jet Propulsion Laboratory, California Institute of Technology, for the U.S. Department of Energy by agreement with the National Aeronautics and Space Administration.

The JPL Solar Thermal Power Systems Project is sponsored by the U.S. Department of Energy and forms a part of the Solar Thermal Program to develop low-cost solar thermal electric generating plants.

ABSTRACT

Recently regulations have become increasingly important to all types of development projects and this trend is especially evident in the electric generating industry. The complex procedures for new plant approval are excellent examples. The introduction of alternate energy technologies into the electric generating industry raises questions concerning the applicability of the existing regulations to the new energy systems.

This report is the first half of a regulatory survey investigating the applicability of existing regulations to small solar thermal power plants. The survey was initiated to support the activities of the Small Power Systems Application (SPSA) project in the siting and implementation of its first engineering experiment.

The issues discussed in this report are generally applicable to a wide range of solar energy facilities but primary emphasis is placed on the regulations applicable to the first Engineering Experiment (EE1). These issues include access to insolation, environmental impact assessment and documentation procedures and utility commission regulations. While preliminary results indicate that the existing body of regulation does not present an obstacle to the implementation of EE1, to promote the commercialization of solar thermal technology several alterations may be beneficial.

The second half of the survey will investigate regulations specific to small solar thermal power plants as though they are being constructed and operated at several representative sites.

ACKNOWLEDGEMENTS

The author acknowledges the participation of several individuals in the preparation of this report. Much assistance in interpreting the legal material utilized was contributed by Robert N. Danziger and Richard L. Anglin. Review and editing essential to the final form of the report were supported by Herbert J. Holbeck, A. L. Walton, Alan T. Marriot, Christopher M. Stevens, and V. C. Truscello.

CONTENTS

I. INTRODUCTION

Regulations are becoming increasingly significant in all types and phases of energy development. The electric generating industry has historically led the industrial sector in the amount of regulatory control under which it must operate and more regulation is added every year. The introduction of alternate energy technologies into the electric generating industry raises questions concerning the applicability of the existing regulations.

To assess the applicability of existing regulations to an experimental 1 MWe, solar thermal-electric power plant, a two-part survey of regulatory requirements is being conducted in conjunction with experimental system design and siting. The first part surveys regulations generally applicable to solar power plants the results of which follow. The second part surveys regulations specific to solar thermal-electric technology should it be implemented at several sites. The results of the site specific survey will be included in the final report. The early identification of applicable regulatory requirements is intended to facilitate experimental plant implementation by reducing regulatory compliance time and the associated monetary expenditures, allowing proportionately more resources to be devoted to experimental objectives and goals.

A. OBJECTIVE

The objectives of surveying the regulatory requirements applicable to solar thermal-electric power plants are: 1) to inform systems engineers early in technology development of performance standards required by various regulatory agencies; 2) to enable site selection teams to include regulatory requirements in site selection criteria; 3) to inform prospective site contractors of the types of permits and licenses which may have to be acquired for plant implementation; 4) to expedite the site participant's acquisition of permits and licenses required by regulatory agencies with jurisdiction; and 5) to ensure positive relationships with regulatory agencies in authority and to establish a cooperative image. To accomplish the above objectives, regulations specific to the unique aspects of solar thermal-electric technology are delineated, the roles of the system contractor and the site participant with regard to permit and license responsibility are indicated, and the regulations applicable to solar thermal-electric power plants as well as conventional electricity generating facilities are identified.

B. BACKGROUND

This report summarizes the results obtained during the first half of the survey on regulatory requirements applicable to the siting and operation of solar thermal facilities. The survey is being conducted to support the activities of the Small Power Systems Applications (SPSA) project in the siting and implementation of its first engineering experiment.

A project originating in the Solar Thermal Power Systems Branch of the Department of Energy, the overall goal of SPSA is to establish the technical, operational and economic readiness of solar thermal technology in the range below 10 MWe. To accomplish this, the project will conduct several field experiments in various test environments. The first 1 MWe engineering

experiment (EE1) has a small community application, and is scheduled to begin operation by the end of calendar year 1982. EE1 involves a system contractor responsible for the development and installation of the power facility hardware and a site participant including an electric utility, responsible for site provision, permit acquisition, connection to a utility electrical network, and other plant support.

Solar thermal power plants collect, concentrate, and focus the sun's direct radiation to heat a working fluid; this in turn drives a heat engine to generate electricity. The basic subsystems of this technology are the concentrator (which refers to both the collector and the receiver), the power conversion unit, energy transport, and energy storage. There are many configurations and designs for each of these subsystems.

Three different types of plant configurations are under consideration for EE1: a point-focusing central receiver plant; a point-focusing, distributed receiver, central energy conversion plant; and a point-focusing, distributed receiver, distributed energy conversion plant. To allow the plant to produce electricity when insolation is unavailable, plant designs may include storage or components which utilize fossil fuels (hybrid systems).

Solar thermal-electric power facilities are similar to conventional generating facilities in several areas. In these areas, solar plants are governed by the same body of regulation applicable to conventional electricity generating facilities. However, some aspects of solar technology are relatively new and unique, and are not addressed by the existing body of regulation. These new and unique aspects raise the issues discussed in this survey.

Special emphasis is placed on issues pertaining directly to specific considerations involved in the implementation of EE1, but whenever possible, the regulations applicable to commercial solar power plants generating up to 10 MW are discussed. Existing regulations already differentiate generating facilities on the basis of size and function. A more stringent set of regulations apply to large generating facilities than those that apply to small facilities. Further, commercial plants are regulated much more extensively than experimental or demonstration plants. This regulatory differentiation is important to the implementation of EE1 because it is both small (1 MWe) and experimental.

C. SCOPE

1. Interim Report

This report discusses the issues investigated in the first half of the survey of regulatory requirements applicable to solar thermal power plants. These issues include zoning and solar easements, environmental impact assessment and reporting procedures, power facility siting procedures, and utility regulatory agency authority. These issues were selected for initial evaluation because they represent national trends or involve federal regulatory agencies. The initial part of the survey also identifies the scope of the subject matter to be included in the final report.

2. Final Report

The majority of the regulations applicable to solar thermal-electric power plants are administered by local, regional and state regulatory agencies. The evaluation of these requirements is the focus of the second part of the survey. To delineate the regulatory requirements at this level, several representative sites are selected for site specific studies. The regulatory issues evaluated are those which apply to site preparation, construction, utility interface, operation and maintenance. Primary emphasis is placed on those aspects of the plant which are unique to solar thermal-electric technology. A flow chart indicating the time frame involved in complying with the identified regulatory requirements is included.

D. APPROACH

The material in this interim report is derived from a literature search and telephone interviews with agency representatives. Included are articles from law journals, reports describing energy legislation, and contact with the individuals responsible for the regulatory permitting of the 10 MWe solar thermal-electric power plant soon to be constructed in Barstow, California.

It is anticipated that the second part of the survey will require additional interviews with various local, regional and state agencies and review of permit and license acquisition procedures. Additionally, research will focus on the clarification of some of the issues discussed here.

The approach taken in the survey of regulatory requirements applicable to solar thermal-electric power plants is to initially evaluate generally applicable regulations and then to analyze specific regulations that deal with the interaction between the solar power plant and its site. This requires the initial focus of the survey to concentrate on federal regulatory agencies and legal trends involving not only solar thermal-electric technology but all solar technologies. As the details of plant implementation are addressed, the applicable regulations become more site and technology specific and thus involve state, regional, and local agencies. By evaluating generally applicable regulations prior to specific ones, it is less likely that any applicable regulations are overlooked. The majority of regulatory authority resides at the level of state government. Exceptions occur when the federal government decrees that an issue is in the national interest and creates a federal agency which preempts the authority of all state agencies regulating that issue. The EPA's jurisidiction over state air and water quality agencies are examples of this preemption. Consequently, it is important to identify the requirements of federal agencies which preempt state regulations early, to avoid conflicts in authority at lower levels.

II. ENVIRONMENTAL IMPACT REPORT PROCEDURES

The National Environmental Policy Act (NEPA) and equivalent state legislation require public agencies with authority over projects which may have significant effects on the environment and which require permits or licenses to assess the extent of the environmental impact the project may have before these permits or licenses are granted. The intent of this legislation is to encourage consideration of environmental factors early in project planning. The following discussion of environmental impact assessment procedures is simplified, but gives a general idea of what is required to comply with this legislation.

Public agencies have adopted guidelines which delineate the procedures by which environmental assessments are performed. Projects funded by or requiring permits and licenses from federal agencies must comply with NEPA, while projects involving state and local agencies must comply with state environmental legislation (in California the California Environmental Quality Act (CEQA)). The agency with the widest jurisdiction over a project or the agency funding the project is designated as the "lead" agency with respect to environmental procedures.

The first solar thermal-electric power plants, including EE1, involve federal, state, and sub-state agencies. While state and local agencies are responsible for approving most permits and licenses, federal agencies are the primary funding sources. As indicated above, this requires compliance with both NEPA and state environmental legislation. Once the technology is more widely adopted and no longer utilizes federal funding, federal agencies will have much less involvement except in states that do not have state agencies equivalent to those at the federal level, because as indicated previously, state and local agencies are responsible for approving most permits and licenses.

EE1 is funded by the Department of Energy (DOE) and must comply with NEPA according to DOE procedures. It is also subject to state environmental legislation if permits are required from state and sub-state agencies. These environmental assessment procedures are very complex and compliance can be resource and time consuming.

A. NEPA

The National Environmental Policy Act of 1969 (NEPA) mandates that the environmental impact of government actions be considered. Its applicability is interpreted to include all development projects which require federal agency approval in the form of permits or funding. NEPA also established the Council on Environmental Quality (CEQ) to interpret and enforce the legislation. Many states have adopted "little NEPAs" which require consideration of environmental impacts associated with development projects requiring state and sub-state agency approval.

The first step in NEPA's environmental assessment process with regard to a specific development project is to determine which, of all the agencies that may be involved, shall have responsibility over environmental impact assessment and thus be the "lead agency". Because EE1 is funded by the Department of Energy (DOE), DOE is the lead agency for environmental

assessment procedures. Once the lead agency is assigned, it may prepare an Environmental Assessment (EA) to determine the significance of the project's impact on the environment. An EA describes the project, alternatives to the project and the impact it may have on the environment. It is evaluated by the lead agency which determines the adequacy of the document and decides whether the impact of the project is significant and therefore requires the preparation of an Environmental Impact Statement (EIS). Although the responsibility for an EA rests with the federal agency, it may be prepared by the applicant and is not required if the lead agency has already determined that an EIS is necessary[6]. If prepared by the applicant, the lead agency remains responsible for its content and quality.

If it is determined from evaluation of the EA that the environmental impact of the project is not significant, the lead agency prepares a Negative Declaration which states the reasons the project does not have a significant impact, and no further environmental documentation is required.

An EIS is a document which discusses the environmental impacts of proposed projects concentrating on the most important, controversial or critical issues. If it is decided that an EIS must be prepared, it is prepared by the lead agency or its contractor with input from other agencies with jurisdiction or expertise. Environmental information may be submitted by the applicant but the lead agency is responsible for the accuracy.

A draft of the EIS is circulated for comments to all agencies that have jurisdiction over the project and agencies with expertise in various aspects of the project. The new CEQ guidelines on environmental reviews require, "all agencies with jurisdiction over a proposal to cooperate so that all review may be conducted simultaneously".[6] Once this process is complete, a final EIS is prepared which responds to all substantive comments. A simplified flow chart of this process is depicted in Figure 1.

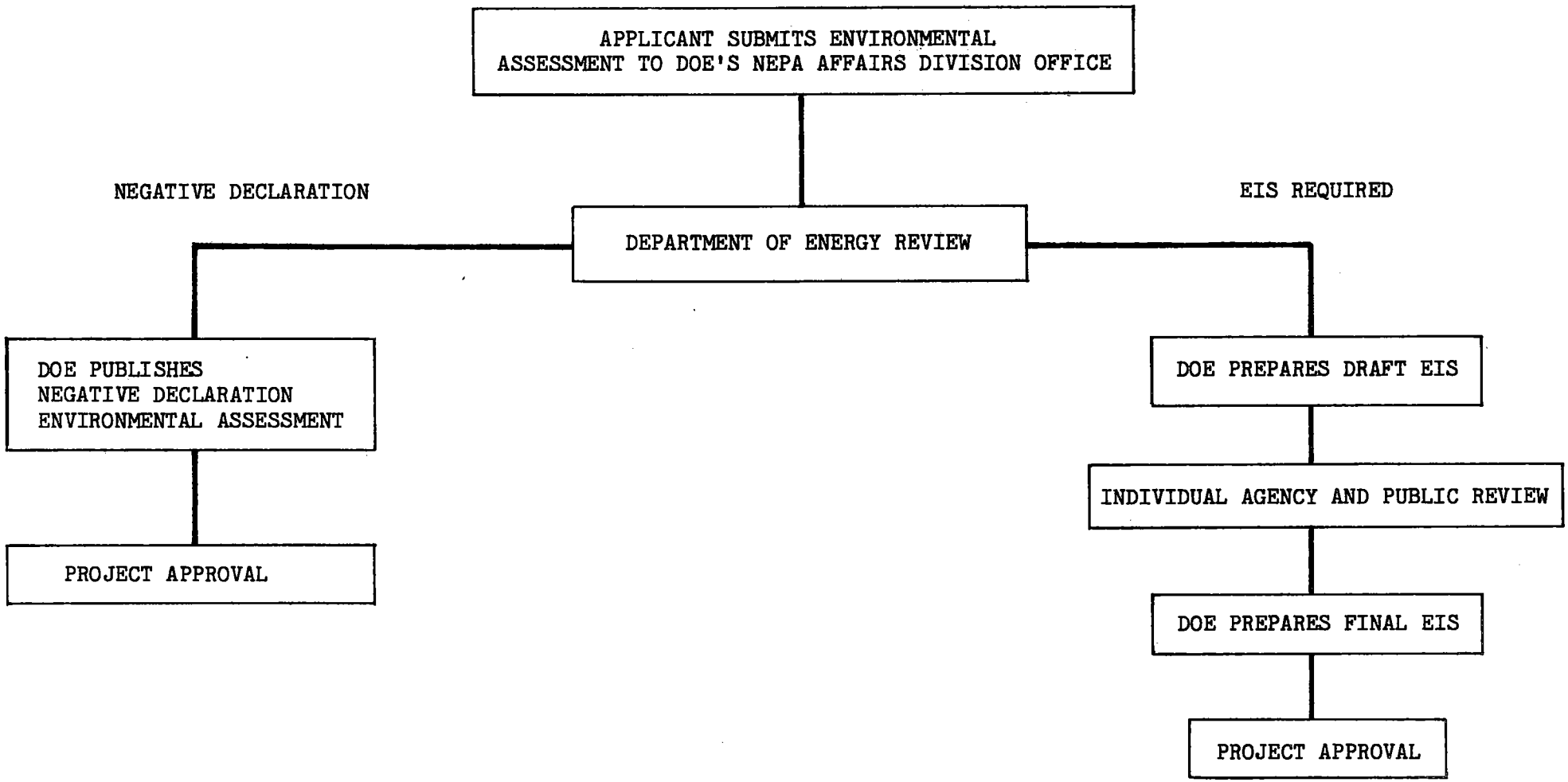
B. STATE ENVIRONMENTAL LEGISLATION

Compliance with state environmental legislation is required of solar thermal-electric power plants if permits and licenses for operation and construction must be obtained from state and local regulatory agencies. Most states have enacted environmental legislation which closely follows NEPA, however, in each state the requirements are different. Under the new CEQ guidelines, federal agencies are required to cooperate in fulfilling the requirements of state environmental impact legislation as well as those of Federal laws so that one document will comply with all applicable laws. However, the new CEQ guidelines will not be in force until July 1, 1979 and there is the possibility that they may be revised. In California, the agency with the widest jurisdiction over a proposed project becomes the lead agency with respect to environmental review. However, if the project is funded by a particular agency, the funding agency may take the lead.

As under NEPA, an Initial Study is prepared describing the project and its anticipated environmental impact. This Study is then used to determine whether or not the project may result in a significant impact on the environment. If the finding is affirmative, the agency must prepare an Environmental Impact Report (EIR) with information submitted by the project proposer. A draft EIR is prepared and circulated for agency and public review. The final EIR discusses the issues identified by the commenting agencies and individuals.

FIGURE 1

ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURES



On the basis of the initial study the lead agency may determine that the project represents no significant impact on the environment. In this case, the agency prepares a Negative Declaration which consists of a brief description of the project as proposed, a finding that the project does not have a significant effect on the environment, a brief statement of reasons to support the findings, and a statement indicating who prepared the Initial Study and where a copy of it may be obtained.

The 1 MWe solar thermal-electric power plant to be constructed as EE1 is not expected to have a significant environmental impact. The experience of the 10 MWe solar thermal-electric power facility under construction at Barstow, California reinforces this supposition. An Environmental Assessment was submitted to DOE by Southern California Edison, and DOE determined the project would not significantly impact the environment and issued a Negative Declaration. The planning agency in Barstow, California responsible for administering CEQA also determined that the plant would not significantly impact the environment and concluded that an EIR was not necessary. However, project proponents prepared an EIR without the legal necessity to do so.[7]

To expedite the environmental review process for EE1, the proposals of prospective site participants will include brief descriptions of the environmental impacts the plant may have on the proposed sites. After preliminary screening, DOE or a DOE designate will compile the environmental information from the proposals that meet the requirements into an EA for use in the final stages of site selection. The preparation of this document may involve contact with the proposers and possibly site visits to clarify the environmental information included in the proposals. The EA is also submitted to the NEPA Affairs Division of DOE where a determination of the significance of environmental impacts of EE1 and the necessity of preparing an EIS will be made.

At the state level, it is anticipated that the lead agency responsible for administering environmental review will be the local planning agency or its equivalent. It is expected that every site proposed for use by solar thermal-electric power plants will require a zone change because it is unlikely that the existing zoning at any proposed site guarantees solar access to the degree that would merit the investment at that site. The petition for a zone change will initiate the environmental review process. Local planning agencies usually have zoning jurisdiction and thus are responsible for environmental assessment procedures. But each state has adopted its own form of environmental protection legislation, therefore the procedures of the state selected to host EE1 must be clearly understood prior to site selection.

III. ACCESS TO INSOLATION

It is obvious that a solar facility can only operate if it receives sunlight. Yet this simple fact stimulates a great deal of speculation over the legal rights of solar energy users to guaranteed solar access versus the rights of surrounding property owners to develop their land. Many approaches to this dilemma have been suggested, the most common are discussed in the following paragraphs. These options are discussed to clarify the alternatives 1-10 MW solar thermal power plants may have during site selection and site preparation regarding the acquisition of a guaranteed right to sunlight.

A. PRESCRIPTIVE EASEMENT

An easement is "an interest in land owned by another that entitles its holder to a specific limited use or enjoyment.

In England a "right to light" is established by prescriptive easement. Under the Doctrine of Ancient Lights, documented in the body of law as the Law Relating to Rights of Light, a landowner may acquire a legal right to the light crossing his neighbor's lands simply by enjoying its use for twenty years. If the neighbor wishes to prevent the establishment of this easement he must take some affirmative action either by erecting a structure which blocks the passage of light across his land, or he may register a "light obstruction notice."[1]

In the United States the acquisition of prescriptive easements to light is deemed impractical because of the rate the country is and has developed.[2] Further, a prescriptive easement to light is a negative easement because it restricts the development of neighboring land parcels. Negative easements are considered to be restrictive covenants or equitable servitude in the U.S. and are discussed in further sections. On the theory that the use of light crossing neighboring property is not interpreted to constitute the type of adverse use usually required to establish a negative easement, prescriptive easements to light are not recognized in American courts. However, the fact that prescriptive easements for light and air are not recognized in the U.S. today does not preclude the possibility that in some future context prescriptive easements to light may become viable.

B. EASEMENTS BY IMPLIED GRANT OR IMPLIED RESERVATION

Implied grants and implied reservations are discussed as "implied grants" because they are very similar. The concept of an "implied grant" to light is accepted in some American courts that reject the concept of prescriptive easements, but most courts find both to be unacceptable. An implied grant is established when a single parcel of land is divided into two parcels and one parcel is sold. An implied grant to light allows the enjoyment of light by the severed parcel of land to be transmitted with that parcel when sold. For example, a developer who builds a house on a large parcel of land and subdivides the land when he sells the house could not build a structure on his remaining land which would block the light enjoyed by the existing house.

To establish an implied grant to light the use of the light must be "reasonably necessary" to the enjoyment of the property. The definition of

"necessity" is interpreted variously by the states. Some states do not recognize an implied grant to light unless the availabiity of light is "a strict necessity" to the enjoyment of the property. Others define "reasonably necessary" as convenience.[2] Although accepted by some American courts, implied easements to light in most cases do not give enough assurance to solar facility owners of an uninterruptible right of access to sunlight. This is in part due to the variable interpretation of "reasonable necessity", and partly due to the fact that implied grants only apply to properties which at one time were owned by the same individual. It does not ensure the right of light to a solar installation developed on a parcel of land subsequent to the original sale dividing the land.

C. EXPRESS EASEMENT

An express easement is one in which the specific limited use is very clearly defined by a grant. Express easements to sunlight can be obtained by prospective solar energy users through negotiation with neighboring property owners. The extent and boundaries of the easement regarding the angles the solar facility receives sunlight during the day and the year must be clearly and carefully described to allow the solar device to collect the insolation required for efficient operation.[2] When acquiring express easements, solar users may be required to pay surrounding property owners for the right of access to the light coming across neighboring land. In principle, if express easements are clearly and correctly drawn, the rights of the solar user will be upheld in court if a dispute arises. Drawn correctly, express easements firmly establish the solar user's right to receive sunlight by restricting the rights of the neighboring property owners from erecting structures or growing vegetation which blocks the passage of sunlight to the solar energy facility.

The acquisition of express easements is optimally suited for developed areas in which the land use is established and unlikely to change. Landowners in developed areas may be more willing to enter into an easement agreement than landowners in undeveloped areas. Their land and the surrounding land has reached its highest potential use and thus the restrictions of the easement agreement will not be perceived by the owners to preclude future development opportunities.

Easements can be drawn in many ways. A description of various easement agreements and the advantages and disadvantages associated with them is beyond the scope of this report. The important point is that the degree of confidence which can be placed in an easement to sunlight by a solar facility owner is a function of the the easement agreement as it is written. In a dispute, courts tend to interpret easement agreements very literally and place the burden of proof on the holder.

The growing popularity of solar heating and cooling devices and the resultant demand for the protection of solar access rights has prompted several states to pass legislation allowing solar easements to be recorded. Prior to the existence of this legislation an easement granting access to light negotiated between property owners was simply a contract between the individuals. Upon sale of the land the easement was not necessarily valid, unless the original land owners stipulated that it would remain in force after sale and the new owner was informed, otherwise the easement would have to be re-negotiated between the new landowners. If the easement is recorded it becomes an encumbrance on the land and remains in force even though the

property ownership changes and the previous owners make no allowances for its continuance.

There are several forms of solar access legislation that have been adopted by the states.[3] Some states simply recognize and record a solar access easement as agreed upon by negotiating land owners. If at any time the easement is threatened, a court will enforce it as written.

Several states have established solar access rights which are similar to legislation protecting water rights in the southwest called "prior appropriation," based on the "first-come-first-served" principle. The initial user of a water resource establishes a right to the use of that quantity of water. Because of its scarcity, if subsequent users were allowed to use the resource it would be degraded, therefore water resources are not available to subsequent users. The application of "prior appropriation" to solar access is implemented in much the same way. Initial users of sunlight establish a right to that sunlight. Litigation arising from a dispute concerning solar rights where solar access is protected by "prior appropriation" are decided in favor of the initial user and other activities are enjoined.

Other states have passed legislation giving priority of access to solar energy users. The use of the sun is recognized and recorded, but litigation arising between property owners could award damages to the solar energy users instead of enjoining the offending activity. Under this legislation a cost/benefit analysis is performed by the court, or an agency or individual appointed by the court, to determine the value of the solar facility's operation versus the value of the offending activity. In states with this type of legislation the right to light is less secure than in the previously discussed cases.

D. RESTRICTIVE COVENANT AND EQUITABLE SERVITUDE

A restrictive covenant is a form of land use restriction commonly used in subdivisions to ensure the homogeneity of a development with regard to architectural style, height, paint, character, etc. Restrictive covenants can also be applied to ensure access to sunlight in developing areas by restricting the height, set-back and density of future development. Or a simple provision can be included in the description of covenants for a development that gives authority to a controlling body to protect access to sunlight in the area on a case by case basis.[4] The use of restrictive covenants is a very workable solution to the problem of guaranteeing solar access to solar facilities in a locality.

E. ZONING AND LAND USE PLANNING

Zoning and land use planning can also be effective tools to provide solar access.[5] Zoning is based on protection of public health, safety and welfare. The conservation of fossil fuels in a time of increasing prices and decreasing supplies is a benefit to the public welfare and therefore zoning to provide for the needs of solar facilities is probably within the bounds of a city's zoning authority.

Zoning devices must be used cautiously to prevent undue hardships in developed areas. Like restrictive covenants, zoning to provide solar access is most appropriate in developing areas.

The implementation of solar thermal-electric technology requires a guarantee of solar access to protect the investment at that particular site. If introduced into a developed area, express easements negotiated with the owners of the surrounding property may represent the most secure guarantee of access. However, because of the relatively large amounts of land required for solar thermal-electric power technology (the 1 MWe engineering experiment requires approximately ten acres) it may be more realistic to assume that these plants locate in sparsely populated and undeveloped areas. In this case, use can be made of restrictive covenants, zoning and land use planning to provide relatively permanent solar access. Locating the plant in a sparsely developed area does not reduce the importance of acquiring solar access, but the procedures to acquire that access may be somewhat simplified by virtue of the fewer interests affected in sparsely developed areas.

IV. UTILITY REGULATION

The introduction of solar thermal-electric power plants into existing utilities may cause many changes in the body of regulation dealing with electricity generation. Present regulation has developed jointly with fossil fueled generating technology and in many instances, may be too restrictive for the developing solar industry. In a time when alternate energy sources, like solar thermal-electric power production, are becoming technologically feasible but are not yet economically competitive, changes in the utility regulatory structure can greatly enhance the timing and integration of solar facilities into the existing electricity generating network. While these issues may not all be pertinent to small experimental facilities like EE1, they are important to the implementation of 10MWe commercial solar thermal power plants. Examples of a few issues important to the integration of solar technology are: 1) inclusion of solar installations in a utility's rate base; 2) introduction of solar technology into a utility's service area in relation to contracts or franchises held by the existing utility; 3) allocation of low cost natural gas to utilities who do not risk investing in solar facilities while those utilities risking a solar investment are bypassed; 4) differential rate structures for solar users; 5) classification of a small solar plant serving a neighborhood as a public utility; and 6) control over siting solar electric facilities by utilities commissions.

A. RATE BASE INCLUSION

To finance the addition of new power facilities, utilities are allowed to include the construction costs of new plants in their rate bases once the new plant is operating. It is to the advantage of the utility to include as many of their costs as possible as early as possible, but this raises the price of electricity to consumers. Electricity rates are calculated to allow utilities a specified rate of return on their investments. The higher the capital base the more revenue can be generated with a fixed rate of return. For this reason, public utility regulatory agencies carefully control the expenditures a utility includes in its rate base.

There are some general rules governing what utilities may include in their rate base; however, each state has adopted its own statutes. Prior to committing to a solar investment, a utility should investigate the statutes of the state in which the plant is located, and seek a declaratory ruling from the agency regulating utilities on the includability of a new solar plant in its rate base.[8] The importance placed on this issue by utilities to a large extent depends on the percentage of generating capacity the power plant represents with respect to the whole utility.

Generally, utility enabling legislation describes plant includability in the following terms: a plant can only be included in a utility's rate base if it can be proven that some benefits of implementing the plant accrue to all of the utility's customers. It must also be determined that the benefits of utilizing the solar plant, incremental fuel and capital savings, offset the cost of the investment. Additionally, the plant must be demonstrated to be economical, have a secure supply of fuel and reliable.[8]

It is presently unknown if solar power plants meet these requirements or if these requirements are appropriate for solar technology. The primary

advantages that solar thermal-electric plants have over fossil fueled plants are that they may be less environmentally damaging. The improvement in environmental quality which may be attributable to solar thermal-electric plants certainly satisfies the requirement that some benefits of implementing the plant accrue to all of a utility's customers. Additionally, all customers are benefited from the fossil fuel a solar power plant saves. It should be reemphasized that all of these determinations are ultimately made by the state utility regulating agency and thus the includability of solar facilities into utility rate calculations may differ from state to state.

The inclusion of EE1 into a utility's rate base in California requires a rate case proceeding conducted by the California Public Utilities Commission (CPUC).[9] It is likely that EE1 and all small experimental plants may be considered research and development activities and expensed. But because most of the costs of EE1 system development and installation are borne by the federal government and the site participant team members share the costs of site acquisition and preparation, the investment the utility makes is relatively low. Therefore the utility may not attempt to include the costs of the solar plant into its rate base.

Large commercial solar thermal-electric plants require large capital expenditures from utilities similar to the cost of traditional facilities. Several ways to encourage utilities to use solar-electric technology may be to allow the construction costs of solar thermal-electric plants to be included in rate bases prior to plant operation, and to allow utilities implementing solar plants a higher rate of return on their investments.

B. UTILITY CONTRACT VIOLATION[10]

It is common for the contract giving electric utilities the right to provide service to contain a clause protecting them from competition that is created by the entrance of new utility companies into the same service area. This practice was initiated primarily to protect the public from the high utility costs and unattractive skyline that would result from the presence of two or more utility company's distribution networks in the same area. The popularity of alternate energy sources raises questions concerning the interpretation of the contract clause restricting utility competition regarding the entrance of alternate energy use into a community already served by a utility. Utilities may interpret the entrance of solar energy facilities into communities they are under contract to serve as a "taking of property." They may consider their right to serve the customers in the area under contract analagous to a homeowner's rights to the house for which he holds the deed.

Because utility monopolies were formed to protect the public from the undesirable aspects of duplicate service, only companies providing duplicate services are banned by the contract clauses granting exclusive service areas. The contract clauses are not interpreted by courts to prevent the entrance of a cheaper or more efficient type of service into the service area, the reason gas and electricity companies are allowed to serve the same territories. The introduction of solar thermal-electric plants which require connection to electricity grids into areas served exclusively by a single electric utility may have to negotiate with the utility in order to operate. However, there may be situations where the solar facility does not interact with the existing utility.

EE1 is not faced with this potential problem since it will not be competing with a utility but will be joining it. However, it is conceivable that future solar thermal-electric plants will be implemented by municipalities or other groups which may be viewed as competitors by the existing utility and in these instances the exclusive service area clause may require careful interpretation.

EE1 may be constructed in the service area of a utility which only distributes power generated by a larger utility and which is prohibited from generating electricity itself. In this case, negotiations with the generating utility may be necessary to allow the distribution utility to utilize the solar thermal-electric plant. The complexity of these issues requires that they are further investigated in the second half of this regulatory survey.

C. NATURAL GAS ALLOCATION

The concern utilities have regarding natural gas allocation is related to allocation changes which may come about as the result of shortages due to natural or man-made causes. Presently, natural gas is allocated to utilities on the basis of a fixed base period. The addition of solar facilities to a utility's generating capacity allows the utility to expand service without requiring a change in their natural gas supplies. The concern arises that the Federal Energy Regulatory Commission (FERC) which allocates natural gas, may see the capacity provided by solar facilities as replacement power for capacity utilizing natural gas, thus freeing a quantity of gas for reallocation to utilities who are in short supply Because the costs of solar thermal-electric power production are today higher than natural gas the utility instituting solar power production is trading cheap generating capacity for expensive capacity and is allowed no expansion to alleviate the high costs. If reallocation occurs, utilities adopting solar power production are penalized while those that do not invest in solar energy benefit by the receipt of additional natural gas.[8] This may be a disincentive for utilities to invest in solar technology. Presently, it is unclear how natural gas may be allocated in the future.

D. DIFFERENTIAL RATE STRUCTURES

Utilities are bound by the Robinson-Patman Act, which makes it illegal to make some purchasers pay more for similar commodities if such discrimination tends to lessen competition or create a monopoly. This means utilities must charge their electricity customers equitable rates. Utilities have many different rate structures for different customers; justified because they benefit all customers directly or indirectly and there is a reasonable basis for distinguishing among different types of customers.

It is unclear how the addition of solar electric power plants would be reflected in utility rate structures. Most of the discussions of differential rate structures for solar energy focus on the electricity rates charged to residential solar energy users requiring backup power from conventional electric plants.[11] Solar thermal electric facilities may only impact the utility's electricity rates like new conventional plants.

The ultimate impact a solar power plant has on rates depends on the percentage of the utility's generating capacity the solar plant represents. In the case of independent hybrid solar facilities which have fossil fueled

components for operation during times insolation is unavailable, a rate structure which suits both the needs of the facility and the needs of the customers is optimal but may be difficult to delineate. Regardless of the rate schedule used, differential rate structures used in hybrid plants is essentially the same as their use in conventional plants.

Rate structures become controversial when the same type of users are charged different rates for the same amount of electricity because some users supplement their energy use with solar generated electricity and some users do not. Several points of view have been expressed on this subject. Proponents of solar energy advocate that lower electric rates should be paid by solar energy users than by those without solar devices because they have invested in an energy form which may benefit everyone by saving fossil fuel and the environment. However, utilities advocate that solar energy users pay higher rates because of the probability that solar users demand conventional utility service during peak demand periods when electricity is the most costly to produce. It is uncertain which viewpoint may be adopted. The decision may depend on overall energy policy. If solar energy use is promoted regulations encouraging its use will be implemented. In either case, differential rates to electricity users based on the use of solar devices are justifiable on the same grounds that differential rates are presently justified; because they benefit all customers directly or indirectly and there is a reasonable basis for distinguishing solar users. The question of differential rate structures is not expected to be an issue in the implementation of EE1 because it is an experimental facility.

E. PUBLIC UTILITY CLASSIFICATION

In most states utilities supplying electric power to the general public are regulated by public utilities commissions. Utilities which generate power for their own use or for a very specific group of individuals regulate themselves and are called private utilities. Utilities owned and operated by municipalities are private utilities regulated by the city's legislative body, but usually closely follow the recommendations of state public utility agencies when setting rates.

The procedures and requirements of utility regulatory agencies are complex. Small generating facilities tend to be disadvantaged if forced to comply with these regulations due to the large financial expenditures involved. It is to the advantage of a small generating facility to be classified a private utility. The Public Utility Regulatory Policy Act (PURPA) of 1978 allows the Federal Energy Regulatory Commission (FERC) to exempt specified small power plants from federal and state public utility regulations.[12] While not yet specified, the plants to be exempted are expected to include small solar electric facilities. Presently in California, electrical generating stations constructed by public utilities under 50 MWe are not required to obtain a certificate of public convenience and necessity. However, regardless of the plant size, in rate proceedings the propriety of allowing the expense of a solar facility to be included in a utility's rate base will be evaluated. As previously discussed, it is likely that early solar facilities like EE1 would be expensed as research and development.

The PURPA exemption is not intended to allow small generating plants to remain unregulated; its primary purpose is to state that present utility regulations are inappropriate. In the next year hearings by FERC on small

power facility regulation will determine the regulatory requirements to be imposed on these facilities. Once the FERC adopts small power facility regulations it is expected that the states will enact similar legislation.

The site for EE1 will be selected before the regulations for small generating facilities are finalized, but the plant will begin operation after these regulations are in effect. In order to facilitate EE1 implementation during these regulatory changes it may be advantageous to select a site participation team which includes a private utility or municipal utility. Although many of the regulatory requirements for private utilities are similar to public utilities, the governing body of private and municipal utilities resides in the local instead of the state level which may facilitate interaction. If a site participation team is selected which includes a public utility, it would be advantageous to select one in a state that exempts small power plants from the requirement to obtain a certificate of public convenience and necessity, and which acknowledges the need for new regulations for small power facilities. A state already tailoring its public utility regulations for the needs of small power facilities may expedite the enactment of regulations similar to those FERC ultimately adopts.

F. POWER FACILITY SITING

The controversy over nuclear power plant siting has prompted several states to adopt legislation delegating final authority over power facility siting to utility regulatory agencies.[13] NEPA did not categorically include power plant siting as an action requiring environmental review and not all state environmental legislation requires environmental review of power plant siting. However, the issuance of certificates of public convenience and necessity must comply with NEPA if a federal agency is involved. Specific, usually power plant, siting regulations have been adopted by many states. In some states siting authority is vested in an agency separate from a utility commission, but often the utility commission encompasses this authority.

Fifteen states have adopted specific power plant siting legislation and of the thirty-nine states that require a power facility to obtain a certificate of "public convenience and necessity", nineteen consider environmental factors during the evaluation. States which have adopted specific power plant siting legislation require a permitting process which often resembles NEPA. Environmental assessment is performed using a multi-disciplinary approach and a report is prepared and circulated for review by agencies with jurisdiction or expertise. However, included in power plant siting procedures is the necessity to determine whether the power plant is needed from the perspective of power production, the implications of a proposed project on a utility's financial standing, and the proposed project's rate implications.[14] This requires long-range energy forecasting which in many cases is defined to be ten years.

Some states with specific power facility siting legislation have combined into a "one-stop" process agency review required for plant certification and siting procedures. However, other states have not coordinated regulatory processes, leaving this burden to the utility. This can further complicate an already time-consuming and complex regulatory process. In Maryland the regulatory process takes four years from the time the initial paperwork is submitted to the utility commission until construction is begun, and can even require more time in some cases.[15]

In each state the procedures for siting and certifying power facilities differ. As in the case for environmental legislation the procedures for facility siting specific to the state which hosts EE1 must be understood prior to site selection. However, as discussed above it may be unnecessary for EE1 to comply with utility regulations governing power plant siting because many states exempt plants generating under 50 MWe.[16]

V. SITE SPECIFIC REGULATIONS

As indicated earlier, an in-depth discussion of the regulations governing site preparation, construction, utility hook-up, operation, and maintenance will appear in the final report. This interim report is devoted to regulatory issues of a more general nature. While the regulatory requirements to be discussed in the final report are site specific, there are general categories of regulation applicable to every site.

A. WATER QUALITY PROTECTION

At every potential site it is expected that a permit will be required for waste water discharge. The federal mandate for this requirement originates in the Federal Water Pollution Control Act and is implemented through the Environmental Protection Agency (EPA) administered National Pollution Discharge Elimination System (NPDES). The legislation does not stipulate discharge standards limiting the amount of specific substances which can be released because the capability to absorb released substances depends on the characteristics of the receiving water. The legislation instead requires that all proposed discharges be carefully evaluated to determine their environmental impact and that mitigation measures be implemented to prevent the released material from causing environmental degradation.

The NPDES permitting procedure is administered primarily by state and local agencies. Compliance procedures usually require a potential discharger to completely describe the composition of its discharges, the manner in which they are to be discharged, and the characteristics of the receiving water. These data are submitted to and reviewed by the agency with jurisdiction, usually a water agency. In California this function is performed by the State Water Resources Control Board through the Regional Water Quality Control Boards. After reviewing the proposed discharge monitoring schedules, the agency issues a permit for the discharge plan that protects water quality in the receiving waters and establishes a monitoring program to assure compliance.

Solar thermal-electric power plants may use water for cooling, energy transport and maintenance activities. However, at this stage in technology development the quantities of water required for these activities is undefined. Water is not required for cooling if dry cooling towers are utilized. Although dry cooling towers are less efficient, their use may be unavoidable if water is not availabile at the selected site. It is estimated that wet cooling towers require 1000 cubic feet of water per day for a 1 MWe solar thermal-electric power plant.

Water, or some other fluid, may be used in the energy transport system. The specific fluids utilized and the quantities needed will depend on final plant design. Maintenance, particularly reflector cleaning, requires water or some other cleaning fluid. Maintenance requirements will not be clearly delineated until the system design is completed.

Water quality regulatory agencies become involved in a project whenever it proposes to use water from the local water resource and dispose of liquid wastes in the local environment. Because it is anticipated that solar thermal-electric plants utilize some quantity of water, agencies protecting water quality are expected to be involved in the siting process.

When the system design for EE1 is finalized and a site is selected, those portions of the plant design which deal with the use and disposal of liquids will be reviewed by the water quality agency with jurisdiction. After review, this agency issues the appropriate permits for water use and disposal subject to conditions requiring additions to the water use and disposal system necessary to protect local water quality, the environment, other users, and the general public. If the quantity of water utilized by solar thermal-electric plants is very small and the discharges do not pose a threat to the environment, the plant may be able to utilize the local sewers for disposal, and thus are only subject to control regarding the quantities of water they use.

B. AIR QUALITY PROTECTION

Air quality regulations are promulgated by the EPA as mandated by the Clean Air Act. The EPA has adopted several review processes for air pollutant sources. Sources emitting large amounts of pollutants are subject to the most strict review procedures, sources emitting lower quantities of pollutants are subject to less complex procedures. Sources of air pollutants are categorized by threshold levels of emissions. Projects are reviewed by category to determine the quantities of pollutants they may emit at the proposed site and not significantly degrade air quality.

The EPA has encouraged state air quality agencies to independently adopt standards similar to those at the federal level. In most cases where a state has issued air quality source review standards they are more stringent than the federal regulations. The California Air Resources Board (ARB) has adopted the following limits:

	lbs per hour
Nitrogen Oxides (NOX)	15
Organic Oxides	15
Particulate Matter	15
Sulfur Oxides (SOX)	15
Non-methane Hydrocarbons	15
Carbon Monoxide (CO)	150

These quantities of pollutants are not the quantities of pollutants stationary sources may emit, they are used as the threshold quantities of emissions to categorize sources for review and regulation. A source emitting these quantities of emissions or higher levels is included in that category of sources required to use the best available air pollution control technology. The quantities of pollutants a source may emit is determined by the ARB or its regional office on a case by case basis. For example, an average 1 MWe oil fired plant burning oil containing 1/2% sulfur produces 0.5 lb of particulates/hr, 0.2 lb of CO/hr, 0.1 lb of hydrocarbons/hr, 7 lb of NOX/hr and 5.3 lb of SOX/hr. If a source emits more than 25 lbs per hour of all the above listed pollutants except CO, and more than 250 lbs per hour of CO even while utilizing the best available control technology it must submit to a regulatory procedure in which a detailed air quality analysis is performed called, "new source review." The threshold limits used in the Southern California Air Quality Management District are lower than the state limits. It is usually true that local and regional agencies, which have adopted their

own air quality regulations, have adopted standards more stringent than those at the state or national level. Thus the air pollution standards with which EE1 must comply must be determined on a site specific basis.

Regardless of the source category described above, if a source proposes to locate in an area which has "clean air", it must comply with yet another pollutant source review procedure. Under the Prevention of Significant Deterioration (PSD) amendment to the Clean Air Act, "clean air", air already of better quality than adopted standards, is not allowed to degrade to the levels of pollution allowed by the national standards.

It is anticipated that the most important air quality issue relative to solar thermal-electric power plants is the impact the local air quality has on the efficiency of the plant and not the impact the plant has on local air quality. This is one of the biggest advantages solar power technology may have over fossil fueled electricity generating facilities. The largest impacts solar plants may have on air quality are expected to occur in the site preparation and construction phases of plant implementation. These impacts could include emissions from fossil fuel burning construction equipment and dust from grading. While the local air quality management agencies may be required to comment on the impact of these activities, primary regulatory responsibility lies in other agencies.

The fossil fueled components of EE1 also impact air quality. The significance of this impact is a function of the type of fuel utilized, the amount of time the fossil fueled components are operated and the nature of the site's air basin. The fossil fueled components of the plant clearly fall under the jurisdiction of the local air quality protection agencies who determine the significance of these impacts once a site is selected. They may also specify mitigation measures to be taken to minimize emissions.

C. PLANT CONSTRUCTION, OPERATION AND MAINTENANCE

Additional major areas of regulation include the Occupational Safety and Health Administration (OSHA), the standardized codes regulating various construction activities like grading, foundations, and structure emplacement, the standardized codes dealing with electrical lines, plumbing and other equipment and possibly solid waste disposal. This is by no means an exhaustive list. The second half of the regulatory survey is devoted to the identification of specific solar thermal-electric plant processes and the regulations which apply to them.

VI. RESPONSIBILITY FOR PERMIT AND LICENSE ACQUISITION

Permit acquisition responsibility for EE1 is divided between the system contractor who provides the plant hardware and the site participant who provides the site. One of the objectives of this regulatory survey is to determine how permit responsibility is allocated. At this point in the survey it appears that the site participant is responsible for all permits and licenses required to obtain use of the site for solar thermal power plant activities and to prepare the site for plant installation, while the system contractor's responsibility encompasses all permits and licenses required for plant construction and operation . Some overlap in responsibility occurs because the system contractor must supply system description data to the site participant. The DOE, because it is the funding agency, has primary responsibility for federal environmental documentation procedures. JPL, the project coordinator, has responsibility for monitoring all permit and license acquisition. Responsibility for permit and license acquisition is shown in Table 1.

TABLE 1

Regulatory Tasks and Responsibility

XX Primary Responsibility
X Review & Monitoring Responsibility or Delegated Responsibility

		JPL	Site Participant	System Contractor	DOE
1)	Site Characterization Data Collection	X	XX		
2)	EA Preparation	X			XX
3)	Environmental Impact Significance Determination				XX
4)*	EIS Preparation	X	X		XX
5)	State Environmental Procedures	X	XX		
6)	Zone Change		XX		
7)	Utility Regulatory Agency Requirements	X	XX	X	
8)	Water Use & Discharge Permits		XX	XX**	
9)	Air Pollution Permits		XX	XX**	
10)	Miscellaneous Site Specific Permits		XX		
11)	Safety and Construction Code Compliance: Site Prep.		XX	XX**	
12)	Safety and Construction Code Compliance: Plant Construction		X**	XX	
13)	Safety Code Compliance O&M	X		XX	

* Unnecessary if DOE NEPA Office determines no significant impacts will result from plant implementation.

** Primary responsibility in these areas depends on the negotiated agreements with the site participant.

VII. SUMMARY

The survey of regulatory requirements applicable to solar thermal power plants indicates that the present body of regulation does not impede the implementation of EE1, but that commercial plants of similar size may benefit from changes in utility regulation to reflect the particular needs of small generating facilities. While most of the regulations discussed in this interim report are generally applicable to all sites, many regulatory requirements are site specific.

It is clear that the instruments best suited for guaranteeing sunlight access to a solar facility are express easements in developed areas and a combination of restrictive covenants and zoning in undeveloped areas. Restrictive covenants linked with zoning are less expensive and more easily implemented than express easements. As the use of solar thermal electric technology increases, the necessity for locating plants in developed areas may increase. Therefore, the use of express easements will also be necessary.

Environmental impact assessment procedures for small solar thermal-electric plants may be abbreviated if Environmental Assessments or Initial Studies are prepared and used for site selection, and the plant design includes aspects which mitigate environmental impacts. However, environmental documentation procedures are very dependant on site specific environmental and regulatory conditions.

EE1 may find the regulatory atmosphere surrounding private utilities more conducive to plant development than that of public utilities because private utilities administered locally may be more willing and capable to tailor their regulations to the needs of EE1, and because they are located locally communication may be facilitated. If EE1 involves a public utility, utility regulatory agencies which acknowledge that a change in utility regulation is necessary to meet the needs of small generating facilities may present a more favorable regulatory environment for EE1 than a utility regulatory agency which does not. Public utility regulatory agencies which exempt generating facilities under 50 MWe from the requirement to obtain a certificate of public convenience and necessity and from siting procedures would also facilitate EE1 implementation.

As the requirements and characteristics of solar thermal-electric power plants become more familiar to users and regulators alike, the position solar plants occupy within the regulatory environment will be clarified. It has been stated earlier that the existing regulations discussed in this report do not present major obstacles to the implementation of EE1, however, it is unclear how solar thermal-electric plants are regulated in day to day construction and operation. In other words, solar thermal-electric plants can be regulated within the existing body of regulation, but the exact procedures are unclear. This is due in part to the site specificity of many regulations, and to the novelty and uniqueness of the technology.

The second part of the regulatory survey clarifies many of the site specific aspects of solar thermal-electric power plant implementation by detailing the regulatory requirements at specific sites. The sites whose regulatory requirements will be investigated will be representative of several different environments. By delineating the regulations EE1 must comply with

at each site, there will be an indication of the problems and procedures EE1 can expect to confront on the site selected for implementation.

At each representative site, the environmental assessment procedures, the best method for acquiring solar access, and the interface with the utility will be delineated. In addition to this, site specific requirements dictating water quality agency regulations, air quality regulations and specific regulations delineating plant construction procedures will be indicated.

Although it may be possible to regulate solar thermal-electric power plants within the existing body of regulation, to encourage the utilization of solar technology it may be necessary to change regulations in ways which motivate solar power plant use or at least allow solar power plants to compete more effectively with conventional electricity generation. Ultimately, the ease with which solar technology is integrated into the electricity generating industry depends on basic policy decisions concerning the role solar energy systems will have in fulfilling energy demand. The investigation of energy policy and possible regulatory change is beyond the scope of this report. This report delineates the regulatory issues which may require alteration if energy policy decisions are made which increase the participation of solar technology in fulfilling the energy demand. Once the basic policy decisions are made, specific regulations will be changed to implement them.

REFERENCES

1. Greene, W. A., "Securing Rights of Light", The Law Journal, Vol. CXII, Nov. 16, 1962

2. Moskowitz, Daniel P. "Legal Access to Light: The Solar Energy Imperative", Natural Resources Lawyer, Vol. IX, No. 2

3. "Electric Power Committee Part 2: The Solar Energy Field", Natural Resources Lawyer, Vol. XI, Number 1, 1978, pg. 19

4. Zillman, Donald N. and Deeny, Raymond, "Legal Aspects of Solar Energy Development", Arizona State Law Journal, 1976:25

5. Association of Trial Lawyers of America, "Securing Solar Energy Rights: Easements, Nuisance, or Zoning?" Based on the essay "Securing Insolation Rights: Ancient Lights, Nuisance, or Zoning?"

6. Council on Environmental Quality, "Implementation of Procedural Provisions; Final Regulations: National Environmental Policy Act, Federal Register, Part 2

7. Personal Communication - Deanne Lynch, Southern California Edison

8. Freeman, John K., "Utility Alternatives for Solar Energy", Public Utilities Fortnightly, Vol. 101, No. 1, Jan. 5, 1978

9. Personal Communication - H. T. Sipe, Chief Electrical Engineer, State of California Public Utilities Commission, Jan. 25, 1979

10. Jones, Kenneth I., White, Sharon S., Owen, Thomas S., Ryan, Robert A., Scott, A. Timothy, Lucey, Stephen F., "Legal Implications of the Adverse Economic Effects which a Municipal Corporation's Implementation of a Solar Energy Plan May Have Upon Privately-Owned Public Utilities", Wilson, Jonesa, Morton & Lynch, 630 North San Mateo Dr., San Mateo, CA 94401

11. Dean, Norman L., and Miller, Alan S., "Utilities at the Dawn of a Solar Age", North Dakota Law Review, 1977

12. Public Utility Regulatory Policy Act (PURPA) - 1978

13. National Conference of State Legislators, Energy: The State's Response, prepared for the Federal Energy Administration, August 1975

14. Foster, Bob, Project Director, Energy Administration and Regulation in California: An Analysis, Staff Report to the Joint Committee on Energy Policy and Implementation, March 1979

15. Berlin, Harriet G., Gill, Kathleen Doyle, Yarrington, Hugh J., "Power Plant Siting -- An Overview of Legislation and Litigation", Environment Reporter, Monograph No. 15, Vol. 4., No. 8, June 22, 1973

16. Personal Communication -- Norm Wilson, California Energy Resources Conservation and Development Commission (CERCDC)

BIBLIOGRAPHY

1. Association of Trial Lawyers of America, "Securing Solar Energy Rights: Easements, Nuisance, or Zoning?" Based on the essay "Securing Insolation Rights: Ancient Lights, Nuisance, or Zoning?"

2. Berlin, Harriet G., Gill, Kathleen Doyle, Yarrington, Hugh J., "Power Plant Siting -- An Overview of Legislation and Litigation", Environment Reporter, Monograph No. 15, Vol. 4., No. 8, June 22, 1973

3. Council on Environmental Quality, "Implementation of Procedural Provisions; Final Regulations: National Environmental Policy Act, Federal Register, Part 2

4. Dean, Norman L., and Miller, Alan S., "Utilities at the Dawn of a Solar Age", North Dakota Law Review, 1977

5. "Electric Power Committee Part 2: The Solar Energy Field", Natural Resources Lawyer, Vol. XI, Number 1, 1978, pg. 19

6. Foster, Bob, Project Director, Energy Administration and Regulation in California: An Analysis, Staff Report to the Joint Committee on Energy Policy and Implementation, March 1979

7. Freeman, John K., "Utility Alternatives for Solar Energy", Public Utilities Fortnightly, Vol. 101, No. 1, Jan. 5, 1978

8. Greene, W. A., "Right to Light", The Solicitors' Journal, July 19, 1968

9. Greene, W. A., "Securing Rights of Light", The Law Journal, Vol. CXII, Nov. 16, 1962

10. Jones, Kenneth I., White, Sharon S., Owen, Thomas S., Ryan, Robert A., Scott, A. Timothy, Lucey, Stephen F., "Legal Implications of the Adverse Economic Effects which a Municipal Corporation's Implementation of a Solar Energy Plan May Have Upon Privately-Owned Public Utilities", Wilson, Jonesa, Morton & Lynch, 630 North San Mateo Dr., San Mateo, CA 94401

11. Moskowitz, Daniel P. "Legal Access to Light" The Solar Energy Imperatives", Natural Resources Lawyer, Vol. IX, No. 2

12. National Conference of State Legislators, Energy: The State's Response, prepared for the Federal Energy Administration, August 1975

13. Personal Communication - Deanne Lynch, Southern California Edison

14. Personal Communication - H. T. Sipe, Chief Electrical Engineer, State of California Public Utilities Commission, Jan. 25, 1979

15. Personal Communication -- Norm Wilson, California Energy Resources Conservation and Development Commission (CERCDC)

16. Public Utility Regulatory Policy Act (PURPA) - 1978

17. Reitze, Glenn L., "A Solar Rights Zoning Guarantee: Seeking New Law in Old Concepts", Washington University Law Quarterly, Vol. 1976, Number 3, Summer

18. "The Allocation of Sunlight: Solar Rights and the Prior Appropriation Doctrine", University of Colorado Law Review, Vol. 47, 1976

19. Zillman, Donald N. and Deeny, Raymond, "Legal Aspects of Solar Energy Development", Arizona State Law Journal, 1976:25