MASTER

AN OVERVIEW OF ENVIRONMENTAL ISSUES: ROOSEVELT HOT SPRINGS KGRA, UTAH

GEOTHERMAL NOISE EFFECTS

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INTRODUCTION

The development and utilization of geothermal energy resources, like many industrial operations, can be a source of unwanted sound. Geothermal industry noise emissions have become a significant environmental issue at The Geysers-Calistoga KGRA in northern California (7). In this KGRA, major geothermal development projects have been constructed or proposed in proximity to a number of small residential communities. Some local residents who have chosen this area for its recreational and retirement values object to increased noise levels resulting from the truck traffic, the drilling of geothermal wells, and the venting of large quantities of superheated steam.

Therefore, it is important to evaluate the potential for environmental noise problems prior to large-scale geothermal development at Roosevelt Hot Springs and other KGRAs in southwestern Utah. This will be accomplished by considering the types of geothermal noise sources to be expected, existing ambient noise conditions within the region, locations of noise receptors, and any applicable regulations or standards. The final step in the analysis will be a definition of key issues relating to noise and an outline of a research program which will help to ensure that geothermal development can proceed without creating unacceptable noise impacts.

ENVIRONMENTAL DESCRIPTION: NOISE

The region of southwestern Utah which includes Roosevelt Hot Springs and other KGRAs is sparsely populated and much of the land has remained under Federal ownership. Major land uses are livestock grazing and, in the valleys, irrigated farming. The few small communities such as Milford, Beaver, and

Fillmore are located five miles or more from the boundaries of the nearest geothermal resource area.

In general, the ambient noise environment appears to be quiet, typical of rural and open space areas. The most significant existing noise sources are associated with transportation corridors. The Union Pacific Railroad runs in a general northeast-southwest direction across the region, passing through Thermo and Beryl and skirting the western boundary of the Roosevelt Hot Springs KGRA. Interstate Route 15, the heavily-traveled highway between Las Vegas and Salt Lake City, goes through the town of Beaver and continues north through the Cove Fort-Sulphurdale KGRA. State highways carrying moderate traffic loads connect local population centers. A major commercial airline route crosses the region and several communities have airfields that are used for general aviation. Finally, agricultural equipment can constitute a noise source in certain places and at certain times. No industrial noise sources of any significance currently exist in the region.

AVAILABLE DATA

Several different types of information are needed in order to adequately resolve geothermal noise issues. These include quantitative data on geothermal noise sources, characterization of ambient noise conditions, the locations of proposed facilities and existing receptors, and noise propagation models appropriate to the physical and meteorological properties of the area. With these data, it is possible to predict the impacts that geothermal projects will have on the noise environment at particular receptor sites and to make recommendations for such noise control measures and other mitigations as may be required.

Geothermal Noise Sources

Although no published noise information is available for geothermal industry operations in southwest Utah, extensive studies of noise emissions have been carried out at The Geysers-Calistoga KGRA in northern California (1, 2, 3, 4, 5, 6, 11). Wells drilled into the vapor-dominated reservoir at The Geysers produce superheated steam at high pressure. The jet noise which results when there is large-scale venting to atmosphere has been the source of the majority of community complaints (7, 9). Sound pressure levels (SPL) over 120 dB(A) have been recorded at 15.2 m (50 ft) from well-venting operations and the noise can be heard at distances of 3.2-4.8 km (2-3 mi) (9, 12). Noise abatement measures have been successful in reducing the frequency of venting episodes and in effectively silencing certain venting procedures, but additional work is needed to bring all sources under acceptable control (7, 17).

Because the geothermal reservoirs at Roosevelt Hot Springs and other Utah KGRAs are of the liquid-dominated type, no venting of superheated steam should occur. Wells can be completely shut-in when necessary, eliminating the need to release geothermal fluid. Furthermore, no venting is necessary when wells are put back into production. Liquid-dominated geothermal fields can therefore be developed and operated without the problem of very high noise emissions. Major noise sources are not expected to exceed 95 dB(A) at 15.2 m (50 ft) and standard noise control measures are available for these sources if required.

A summary of noise sources expected to accompany geothermal resource development in southwest Utah is given below, along with typical SPL ranges.

1. Road and Site Preparation.--Especially during the exploration and field development stages, heavy earth-moving equipment is used to prepare roads, drill pads, sumps, and sites for the power plant and other facilities. Data from the EPA document PB 206 717 suggest a SPL range of 70-95 dB(A) at 15.2 m (50 ft) (13).

2. Well Drilling.--The well-drilling operations begin with exploration, of course, but continue through the production stage as make-up wells are needed to replace original wells whose yield has fallen off. The dominant noise sources associated with drilling are the large diesel engines which power the rotary rig and mud pumps. Typical SPL during drilling with mud as the circulating medium ranges from 75 to 85 dB(A) at 15.2 m (50 ft) (17).

Compressed air is routinely used as a circulation medium in the final phase of drilling at The Geysers; the large compressors and the release of the air to atmosphere can be troublesome noise sources with SPL up to 5 dB(A) above that recorded for mud drilling (17). Since this procedure is not normally used in liquid-dominated reservoirs, it should not be of concern in the southwest Utah KGRAs.

3. Production Testing.--The process of flowing geothermal wells to test production capability begins in the exploration stage and will occur periodically for the life of the field as new make-up wells are drilled. No noise measurements are available for this procedure at Roosevelt Hot Springs, but some data from Imperial Valley in California suggest that SPL should be well below 90 dB(A) at 15.2 m (50 ft) (P. Leitner, unpubl. data).
4. Facilities Construction.--Construction of the power plant, pipelines, and transmission lines involves the use of many standard pieces of heavy motorized equipment. The resulting SPL can be estimated at 70-95 dB(A) at 15.2 m (50 ft) by reference to the EPA document PB 206 717 (13).
5. Operation of Geothermal Field and Power Plant.--The noise emission characteristics of geothermal power plants, including turbine building, cooling tower, and steam jet ejector system, are well-documented and adequate data are readily available. SPL of 75-85 dB(A) are typical at 15.2 m (50 ft) from the cooling tower, the dominant noise source (4, 10). Other potential noise sources are the flash units in which a portion of the geothermal fluid is allowed to flash to steam. These units will probably be located at the wellheads, although the exact design of the flash system is not known with certainty. SPL at 15.2 m (50 ft) from a flash unit undergoing testing in Imperial Valley was measured at 85 dB(A) (P. Leitner, unpubl. data).
6. Vehicular Traffic.--Auto and truck traffic is an important source of noise throughout the life of any geothermal project, with maximum SPL ranging from 70-95 dB(A) at 15.2 m (50 ft) depending on the type of vehicle (14).

Ambient Noise Environment

Woodward-Clyde Consultants (San Diego) is currently carrying out a one-year ambient noise survey at the Roosevelt Hot Springs Unit, which includes Federal lands under lease to Phillips Petroleum Company for geothermal resource development (18). Measurements of A-weighted SPL are being taken quarterly at various unspecified points within the unit, at its boundary lines, and at nearby residences. Sampling at these locations is done for several 10-min periods over two days in each quarter. The data are analyzed to provide values for equivalent A-weighted SPL (L_{eq}), day-night average A-weighted SPL (L_{dn}), and the L_{max} , L_{10} , L_{50} , and L_{90} statistical descriptors. The latter parameters represent the maximum SPL recorded, the A-weighted SPL equaled or exceeded 10% of the time, and so on. A description of major noise sources at each sampling station will be provided, as well as a map showing the location of each point where measurements were made. A report including these data on baseline noise conditions at the Roosevelt Hot Springs Unit will be available early in 1979.

This study seems well-designed and should provide an adequate description of the existing ambient noise environment in the Roosevelt Hot Springs KGRA as a whole. Under the requirements of the Geothermal Steam Act of 1970, it is expected that similar baseline noise surveys will be carried out in other areas where exploration indicates the presence of geothermal reservoirs with potential for commercial development (8). Thus, the Cove Fort-Sulphurdale and Thermo Hot Springs KGRAs are likely to be the next priority locations for ambient noise investigations.

Noise Receptor Sites

Residences, schools, and health care facilities are particularly sensitive to noise intrusion and require special consideration in the planning of any

industrial project which may be a significant source of noise. The major geothermal resource areas of southwest Utah are generally remote from such noise receptors. Nevertheless, it is possible that some isolated receptors such as ranch houses are located close enough to the boundaries of geothermal leases to be impacted by project noise emissions. No maps of noise receptor sites are available for any of the KGRAs in the region.

Noise Propagation Models

Once noise sources have been identified and characterized and the location of sensitive receptors has been determined, an adequate noise propagation model will allow accurate prediction of SPL and frequency spectra at the receptor. Methods which are currently in use at The Geysers-Calistoga KGRA in California seem to give reasonable results and can be adapted for use at Roosevelt Hot Springs and other Utah KGRAs where needed (4, 10, 12). These field-tested noise propagation models indicate that an attenuation of at least 40 dB can be expected over a distance of 0.8 km (0.5 mi). This suggests that the loudest noise sources expected at Roosevelt Hot Springs and other southwest Utah KGRAs could easily meet the U.S.G.S. criterion of 65 dB(A) at that distance.

Noise Criteria

Community Noise

The so-called "Levels Document" published by the EPA identifies environmental noise levels which, according to the best available scientific studies, appear to protect against community annoyance and activity interference (15). The criterion proposed in this document for residential areas, schools, and hospitals is an outdoor day-night average A-weighted SPL of 55 dB. This level provides useful guidance in judging the acceptability of noise intrusion, but in no way represents

a Federal standard. It does not consider the economic or technological feasibility of attaining such a level, nor does it consider local needs and attitudes.

The State of Utah has no laws regulating community noise levels. Local government units may enact ordinances setting noise standards appropriate for residential, commercial, or industrial land use zones and may place limits on noise projecting from one property to another. However, none of the cities or counties within the geothermal resource area of southwest Utah have as yet adopted such regulations.

The only published environmental noise criterion which would specifically apply to geothermal industry operations is that contained in the U.S.G.S. Geothermal Resources Operational Order No. 4 (16). This document states that geothermal-related activities on Federal leases shall not exceed a noise level of 65 dB(A) at the lease boundary or at 0.8 km (0.5 mi) from the source, whichever is greatest. No such criteria exist for geothermal operations on land leased from the State or from private owners.

Domestic Livestock and Wildlife

There are no generally accepted criteria which would apply to the prevention of adverse noise effects on animals. It must be assumed, in the absence of definitive studies, that application of the criteria suggested for humans in the EPA "Levels Document" will serve to protect animals against behavioral and physiological damage from noise (15).

KEY ISSUES AND REQUIREMENTS

It seems clear that environmental noise will not be a serious concern at Roosevelt Hot Springs or other KGRAs in southwest Utah. Geothermal industry noise

sources will be of moderate intensity and proposed locations of development activity appear to be remote from residential communities and other sensitive receptor sites. Nevertheless, certain issues concerning geothermal noise effects can be identified and may be listed as follows:

1. What are the noise levels associated with the various stages of the geothermal development process?
2. What will be the effects on the noise environment of local communities? What impacts on domestic livestock and wildlife can be anticipated?
3. What are appropriate noise criteria to prevent adverse effects on the public welfare? Will new regulations or special noise control technology be required?

RECOMMENDED RESEARCH PROGRAM

In general, adequate data are available from various sources to assess the potential for environmental noise problems from geothermal resource development in southwest Utah. However, certain additional pieces of information would be very useful in helping to resolve the issues which have been identified in this report.

Source Term Measurements

Sound pressure levels and frequency spectra are not available for some geothermal operations which may be important noise sources. These operations include (1) test flowing of full-scale fluid production from individual wells and (2) the operation of flash units at the wellhead or near the power plant to separate steam from residual hot water. Noise data for these processes could be gathered easily in the field at the appropriate time either by development companies or interested government agencies.

Ambient Noise Measurements

Existing environmental noise conditions should be documented prior to development at all sites where commercial use of geothermal resources is proposed.

The study design used at the Roosevelt Hot Springs Unit by Woodward-Clyde Consultants is quite adequate to provide a quantitative noise baseline description. It should be possible for the developers in each KGRA to carry out or fund a cooperative baseline study which would yield regional data applicable to all leases. Ambient noise surveys would be appropriate at the Cove Fort-Sulphurdale and Thermo Hot Springs KGRAs in the near future.

Noise Receptor Sites

Maps should be prepared for each KGRA and its environs showing the location of any noise receptor sites such as residences. This mapping effort should cover an area up to two miles beyond the boundaries of the KGRA.

Noise Criteria

Since the potential for serious noise effects from geothermal industry activities appears to be very low, it does not seem necessary to develop new criteria or to propose additional regulations.

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