

## DOCKETED

<b>Docket Number:</b>	09-AFC-07C
<b>Project Title:</b>	Palen Solar Power Project - Compliance
<b>TN #:</b>	202786
<b>Document Title:</b>	Response to Request for Clarification Regarding Solar Flux-Related Avian Mortalities
<b>Description:</b>	From United States Department of the Interior, Fish and Wildlife Service
<b>Filer:</b>	Alicia Campos
<b>Organization:</b>	CEC / U. S. Dept of Interior, Fish & Wildlife Service
<b>Submitter Role:</b>	Public Agency
<b>Submission Date:</b>	7/24/2014 8:19:55 AM
<b>Docketed Date:</b>	7/24/2014

# Memorandum

To: **California Energy Commission**  
1516 Ninth Street  
Sacramento CA 95814-5512

Date : July 23, 2014

From : **United States Department of the Interior,  
Fish and Wildlife Service**  
1490 East Main Street  
Ashland, Oregon 97520

Subject: **RESPONSE TO REQUEST FOR CLARIFICATION REGARDING SOLAR FLUX-RELATED  
AVIAN MORTALITIES**

This July 21, 2014 letter from the Fish and Wildlife Laboratory was submitted in a response to two questions staff biologist Chris Huntley posed to Dr. Espinoza, one of the authors of the Forensic Laboratory Study, regarding avian mortality and the ability to detect the cause of death for birds without visible feather singeing. Mr. Huntley asked Dr. Espinoza the following questions: " Could a bird die from exposure to concentrated levels of elevated solar flux without showing visible evidence of feather burning? And if so, would a necropsy or other test be able to show that this was the cause of death?" Staff asked these questions to help clarify if birds could die from exposure to solar flux without exhibiting visible evidence of feather singeing.



IN REPLY REFER TO:

# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

Office of Law Enforcement

Clark R. Bavin

National Fish and Wildlife Forensics Laboratory

1490 East Main Street

Ashland, Oregon 97520

## Response to request for clarification regarding solar flux-related avian mortalities

Rebecca A. Kagan, Tabitha C. Viner, Pepper W. Trail, and Edgard O. Espinoza

July 21, 2014

Special Agent in Charge Jill Birchell requested a response to the following questions:

*Could a bird die from exposure to concentrated levels of elevated solar flux without showing visible evidence of feather burning?*

**Answer:** All of the Ivanpah birds that died from solar flux exposure showed visible evidence of feather burning. Studies of thermal effects in tissue culture indicate that brief exposure to elevated temperatures below the level sufficient for feather singeing can cause cell death. However, we have yet to find evidence of such effects in birds exposed to solar flux.

*And if so, would a necropsy or other test be able to show that this was the cause of death?*

**Answer:** Necropsy (post-mortem) examination should be able to demonstrate tissue damage in birds exposed to solar flux, even if this resulted from exposure too low to cause feather singeing. Such a study would require an adequate sample of carcasses that have not undergone decomposition or other post-mortem deterioration.

---

**Discussion.** The Pathology Section of the National Fish and Wildlife Forensics Laboratory received 95 bird carcasses from the Ivanpah facility whose condition allowed for cause of death determination. Solar flux exposure was the cause of death for 47 of these birds, which exhibited external damage ranging from feather singeing to whole-body charring. Of the remaining 48 birds, over half of the deaths were directly related to the facility infrastructure (building, vehicle, heliostat collisions and power line electrocution).

We determined that a minimum temperature of 400° Celsius is required to damage feathers. The question remains whether birds exposed to lower, but still potentially fatal, temperatures suffer soft tissue burns and/or hyperthermia.

Birds flying through the solar flux at various speeds and distances from the power tower will encounter a range of elevated temperatures. Exposure to temperatures as low as 65° Celsius for 5 seconds and 160° Celsius for 0.3 milliseconds has been shown to cause cell death in laboratory studies (Simanovskii et al., 2005). This suggests that some birds exposed to solar flux could experience temperatures sufficient to cause death without producing feather burns. Feathering, body size and time spent within the solar flux field are variables that may affect the character of injury.

Bird carcasses from Ivanpah with feather singeing often (but not always) also had extensive skin charring and other tissue damage. However, we found no evidence of thermal injury to skin or other organs in birds lacking feather singeing. No tissue damage was detected on the four singed birds that were recovered alive at Ivanpah and subsequently died at rehabilitation facilities. Surface burns, such as skin burns, should be detectable during post-mortem examination (visible grossly and/or microscopically) within minutes to a few hours after exposure. Systemic signs of hyperthermia, such as multi-organ damage and failure, develop within 24 hours. A post-mortem examination may fail to detect these changes if the bird dies rapidly or if the carcass is decomposed. Additionally, subtle early changes may be indistinct if the carcass has been frozen and thawed prior to examination.

The results of our preliminary study demonstrate that significant avian mortality is caused by the intense solar flux that produces feather singeing. No evidence was found for avian mortality caused by lower levels of solar flux exposure. However, birds with damage that did not result in immediate death or flight impairment, may have flown outside of the area where birds were collected. These birds may have died later in time, or sustained injuries that impaired breeding or survivorship. Due to the post-mortem deterioration of many of the carcasses we examined, as well as our relatively small sample size, further research would be needed to clarify whether avian mortality occurs due to exposure to lower levels of solar flux.

It is important to note that the Forensic Laboratory analyses were performed on carcasses collected while the Ivanpah facility was being constructed and tested. Solar flux-related deaths are likely to increase when the facility becomes operational at full power.

Simanovskii D., M. Sarkar, A. Irani, C. O'Connell-Rodwell, C. Contag, A. Schwettman and D. Palanker. "Cellular tolerance to pulsed heating". SPIE Proceedings, Laser-Tissue Interactions XVI, vol. 5695, BIOS 2005.