

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

California Independent System Operator) Docket No. ER07-1034-002
Corporation)

**SUMMARY OF PREPARED DIRECT TESTIMONY
OF
SONGZHE ZHU**

In her direct testimony, Songzhe Zhu describes the interconnection study process relating to the Green Borders geothermal project, with a focus on the telecommunications facilities which this process has determined are necessary for the interconnection of Green Borders to the CAISO Controlled Grid. Ms. Zhu explains that although the initial studies for Green Borders identified over \$217 million in network upgrades, revised studies incorporating the congestion management protocols that will be implemented as part of the CAISO's new MRTU market design significantly reduced the scope of necessary upgrades. Ms. Zhu outlines the upgrades indicated by the revised studies, which include certain telecommunications facilities.

Ms. Zhu goes on to discuss the telecommunications facilities in greater detail, stating that these facilities are necessary in order to allow for the tripping of the Green Borders facilities under certain contingency conditions. Ms. Zhu explains that for generators that interconnect through a dedicated generation tie line, a tripping signal can be sent directly from protection facilities on the grid to the point at which the generator's radial line ties into the transmission system. However, because Green Borders plans to interconnect to the CAISO Controlled Grid through a third-party line that already serves

as the means of interconnection for an existing generator, telecommunications facilities must be constructed to allow a tripping signal to be sent directly from the grid to Green Borders, so that the Green Borders project can be isolated from the grid without disturbing service to the existing generator.

1
2
3
4 **UNITED STATES OF AMERICA**
5 **BEFORE THE**
6 **FEDERAL ENERGY REGULATORY COMMISSION**
7

8
9 **California Independent System Operator) Docket No. ER07-1034-002**
10 **Corporation)**
11

12
13 **PREPARED DIRECT TESTIMONY**
14 **OF**
15 **SONGZHE ZHU**
16
17

18 **I. INTRODUCTION**

19 **Q. Please state your name and business address.**

20 **A.** My name is Songzhe Zhu. My business address is California ISO, 151 Blue
21 Ravine Road, Folsom, California 95630.
22

23 **Q. By whom and in what capacity are you employed?**

24 **A.** I am employed by the California Independent System Operator Corporation
25 (“CAISO”) as a Senior Regional Transmission Engineer. I have held this position
26 from September 2006 to the present time. My job responsibilities in this position
27 include performing complex engineering studies to anticipate, identify and resolve
28 problems or potential problems with the southern California power grid,
29 conducting planning studies and overseeing and approving transmission projects
30 proposed for the CAISO Controlled Grid, and performing interconnection studies
31 for generation interconnection projects.

1

2 **Q. Please describe your professional and educational background.**

3 **A.** I received a Ph.D in electrical engineering from Iowa State University in 2000.
4 Previously, I received an MSEE (Master of Science in Electrical Engineering)
5 from Nanjing Automation Research Institute in China in 1996 and a BSEE
6 (Bachelor of Science in Electrical Engineering) from Xian Jiaotong University in
7 China in 1993.

8

9 After graduating from Iowa State University in 2000, I worked for Perot Systems
10 as an Application Specialist from March 2000 to August 2000. While at Perot
11 Systems, I developed various software applications to facilitate trading and
12 settlement of the hour-ahead and day-ahead energy market for the California
13 Power Exchange. Thereafter, from August 2000 to May 2006, I worked as a
14 software engineer and then as a senior software engineer at Siemens PT&D, in
15 San Jose, California. As a software engineer, my job function was to design,
16 develop, intergrate and implement advanced power applications software for use
17 in energy management systems (“EMS”). In May 2006, I joined the CAISO,
18 working in the EMS Information Technology division as an EMS Engineering
19 Specialist. In September 2006, I transferred to my current position as Senior
20 Regional Transmission Engineer.

21

22

23

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Q. Please describe your role in the development of the Green Borders studies and LGIAs

A. I have worked on the the Green Borders interconnection project since being assigned to the project in November 2006. My work on the project has included drafting the second Technical Assessment Study (“TAS II”) plan,¹ which was finalized in September 2007 to assess the proposed interconnection of the Green Borders facility, participating in the preparation and overseeing the finalization of the TAS II study report dated December 12, 2007,² and participating in preparation of the Facilities Study Revision 1 report which was issued in April 2008.³

In order to perform my work on the TAS II study plan, TAS II study report and Facilities Study Revision 1 report, it was necessary for me to review and analyze previous studies and study reports that had been prepared for Green Borders prior to September 2006 because all of the various studies performed for Green Borders are interrelated, and it was necessary to incorporate the information contained in the earlier studies and study reports into the updated study reports that I was required to complete. The prior reports and studies that I analyzed consisted of (1) the July 5, 2005, System Impact Study (“SIS”), published by Southern California

¹ See Exhibit No. JST-5.

² See Exhibit No. JST-6.

³ See Exhibit No. JST-7.

1 Edison (“SCE”), which identified several potential overload conditions and
2 indicated that certain upgrades were required for the interconnection of the Green
3 Borders facility;⁴ (2) the April 4, 2006 Technical Assessment Study (“TAS” or
4 “original TAS”), which SCE conducted to analyze the load flows resulting from
5 interconnection of the facility;⁵ and (3) the initial Facilities Study, which was
6 published by SCE on June 16, 2006.⁶

7

8 In addition to my work on the study plan and reports mentioned above, I assisted
9 in putting together a form of LGIA which was submitted to Green Borders in
10 December 2006, and, later, the unexecuted LGIA which was filed with the FERC
11 on June 14, 2007.

12

13 **Q. What is the purpose of your testimony?**

14 **A.** The purpose of my testimony is to describe the communications facilities which
15 the CAISO’s studies have determined are necessary for the interconnection of the
16 Green Borders facility, and to place those telecommunications upgrades in the
17 context of the total package of interconnection facilities and network upgrades
18 that those studies identified for the Green Borders interconnection.

19

20

⁴ See Exhibit No. JST-2.

⁵ See Exhibit No. JST-3.

⁶ See Exhibit No. JST-4.

1

2 **II. OVERVIEW OF GREEN BORDERS INTERCONNECTION**3 **Q. Please provide a brief description of the Green Borders project and an**
4 **overview of the plan of interconnection.**5 **A.** Green Borders Geothermal (“Green Borders”) is a proposed 62 MW geothermal
6 generating facility to be located in Mineral County, Nevada that applied for
7 interconnection to the CAISO Controlled Grid on February 22, 2005. Green
8 Borders plans to interconnect the CAISO Controlled Grid at the SCE substation
9 known as the “Control Substation” by way of a 12-mile 230 kV generation tie line
10 that will run from Green Borders to the existing Dixie Valley-Oxbow 230 kV
11 transmission line, which in turn connects to the CAISO Controlled Grid at SCE’s
12 Control Substation. The Dixie Valley-Oxbow line is owned by Oxbow
13 Corporation, and currently serves as the means of interconnection between a
14 Qualifying Facility owned by Oxbow (the “Oxbow QF”) and the CAISO
15 Controlled Grid. Green Borders would also construct and own a new “Aurora”
16 switching station located adjacent to the Dixie Valley-Oxbow line. The Dixie
17 Valley-Oxbow line would be looped in and out of the new Aurora station. A one-
18 line diagram depicting this configuration is contained in Exhibit No. JST-9.

19

20 **Q. Were there other upgrades identified as necessary to interconnect the Green**
21 **Borders project?**22 **A.** Yes. The original TAS, prepared by SCE, determined that the existing
23 transmission system was not adequate to support the interconnection of the Green

1 Borders project, because the project would trigger new or aggravate existing
2 overloads under base case and single and double contingency conditions. In order
3 to mitigate these conditions, the TAS indicated that a number of upgrades were
4 necessary, including the expansion of the existing Inyokern Substation, the
5 addition of a new transformer at the existing Lugo Substation, the construction of
6 a new 220 kV transmission line, and the installation of a new Special Protection
7 System (“SPS”).⁷ The original Facilities Study estimated the cost of these
8 upgrades at approximately \$217,732,000.

9

10 These upgrades were incorporated into a proposed Large Generator
11 Interconnection Agreement (“LGIA”), which SCE tendered to Green Borders and
12 the CAISO on December 16, 2006. Green Borders declined to execute this LGIA
13 (the “original LGIA”), and, on June 14, 2007, at Green Borders’ direction, the
14 CAISO and SCE filed the original LGIA with the Commission. Green Borders
15 protested the original LGIA, and, on August 10, 2007, the Commission issued an
16 order accepting the proposed agreement for filing, subject to refund and initiated
17 settlement procedures.

18

19 **Q. What was the result of the settlement discussions?**

⁷ Special Protection Systems consist of relays and other equipment designed to curtail generation in specific areas in order to prevent transmission line and transformer bank overloads and system instability when faced with transmission outages. Special Protection Systems were previously referred to as “Remedial Action Schemes.”

1 A. As a result of the settlement discussions, SCE, Green Borders and the CAISO
2 agreed that SCE would restudy the interconnection request for Green Borders, in
3 order to explore whether enhanced congestion management protocols to be
4 implemented as part of the CAISO's Market Redesign and Technology Upgrade
5 ("MRTU") market design, which is scheduled to go live in early 2009, could be
6 utilized as an alternative to certain transmission upgrades originally identified in
7 the TAS and original Facilities Study.

8

9 **Q. Please describe the restudies and the conclusions reached therein.**

10 A. In the fall of 2007, the TAS II study was performed, which concluded that, under
11 the congestion management protocols to be implemented under MRTU, some of
12 the network upgrades identified in the original TAS would no longer be required,
13 so long as tripping of the project could be incorporated into certain existing SPSs.
14 Specifically, the TAS II determined that application of the MRTU congestion
15 management protocols (which will allow for forward scheduling, thus ensuring
16 that feasible schedules are implemented in the day-ahead and hour-ahead
17 timeframes) would be adequate to manage base flows on the transmission lines
18 affected by the Green Borders interconnection. However, the TAS II concluded
19 that it would still be necessary to have the capability to trip the Green Borders
20 generator, in order to ensure system stability under certain outage conditions
21 relating to specific transmission lines and transformer banks. This tripping
22 requirement would be satisfied by incorporating the Green Borders facility into
23 the existing SPSs at the Bishop, Kramer and High Desert facilities.

1

2 In April of 2008, the CAISO released a revised Facilities Study referenced as
3 “Facilities Study Revision 1,” which estimated a total cost of approximately
4 \$27,000,000 to implement the following upgrades, as identified in the TAS II:

- 5 • Equipment replacement and upgrades at four SCE substations.
- 6 • Upgrades to the Bishop, Kramer and High Desert SPSs in order to
7 incorporate the tripping of the Green Borders project under certain
8 contingency conditions.
- 9 • Installation of fiber-optic and microwave telecommunications channels
10 in order to support the upgraded SPSs.
- 11 • Installation of new RTUs at the Green Borders facility and the Kramer
12 Substation.
- 13 • Inspection, testing and installation of new revenue-quality meters at
14 SCE’s Control Substation.

15

16 **III. CONFIGURATION OF COMMUNICATIONS FACILITIES**

17 **Q. Can you please describe in greater detail the telecommunications equipment**
18 **that the TAS II and Facilities Study Revision 1 identify as being necessary to**
19 **implement the Green Borders interconnection?**

20 **A.** Yes. The Facilities Study Revision 1 identified the following telecommunications
21 facilities as part of the overall package of upgrades: (1) an approximately sixty-
22 eight mile fiber optic cable, to run between Control Substation and the proposed
23 Aurora switching station and (2) microwave equipment to be installed at the

1 Green Borders project, the proposed Aurora switching station, and three
2 communication sites owned by the Los Angeles Department of Water and Power
3 – Aurora Peak, South Benton Range, and Poleta Canyon. A more detailed list of
4 the components making up these systems can be found on page 63 of Exhibit No.
5 JST-8.

6

7 **Q. Why are these communications facilities necessary?**

8 **A.** As I stated earlier, to mitigate the adverse impact of the addition of the Green
9 Borders project to the CAISO Controlled Grid, tripping of the project needs to be
10 incorporated into the existing Bishop, Kramer, and High Desert SPSs. For most
11 projects, such tripping would occur at the point at which the radial line to the
12 generator tied into the transmission system, usually at a substation. However,
13 because the Green Borders project will interconnect to the CAISO Controlled
14 Grid via the existing Dixie Valley-Oxbow 230 kV transmission line, which serves
15 as the means of interconnection for the Oxbow QF, full redundant
16 telecommunication routes must be constructed from the Control substation to the
17 new Aurora switching station, in order to send the tripping signal to the project
18 while still allowing the Oxbow QF to remain in service. The fiber optic cable and
19 microwave facilities will allow the SPS systems to monitor and control the circuit
20 breakers at the Aurora switching station and at the generator's switchyard, such
21 that, in cases of emergency, the Green Borders project can be isolated from the
22 grid, without disturbing service to the Oxbow QF.

23

1 **Q. Does this mean that, if Green Borders had planned to interconnect to the**
2 **CAISO Controlled Grid via a dedicated generation tie line for its own facility,**
3 **then these telecommunications facilities would not be necessary?**

4
5 **A.** That is correct. For projects that interconnect directly to the grid via a dedicated
6 generation tie line, a tripping signal can be sent directly from the SPS to the point
7 at which the generator's radial line ties into the transmission system. No special
8 telecommunications facilities are necessary under such circumstances in order to
9 implement the tripping capability of the SPS. Therefore, the telecommunications
10 facilities identified in the Facilities Study Revision 1 are necessitated solely
11 because of Green Borders' election to interconnect to the CAISO Controlled Grid
12 via the existing Dixie Valley-Oxbow line. In effect, they provide a substitute
13 means of communication between the generating facility and the grid which
14 would normally be accomplished through a dedicated tie line.

15
16 **Q. Do the fiber optic cable and microwave facilities serve the same purpose of**
17 **allowing the SPS to trip the Green Borders project without curtailing service**
18 **to the Oxbow QF?**

19 **A.** Yes. The fiber optic cable will be the primary means of communication between
20 the SPS systems and the Green Borders project. The purpose of the microwave
21 facilities is to provide a second and independent telecommunication route for the
22 tripping signal to be sent to the Green Borders facility, in the event of a
23 contingency affecting the fiber optic cable, in accordance with WECC criteria.

1

2 **Q. Why do the revised studies plan for some of the microwave facilities to be**
3 **located at existing LADWP communications sites?**

4 **A.** Based on the location of the Green Borders project in relation to the CAISO
5 Controlled Grid, installing a number of the microwave facilities at existing
6 LADWP sites, at which there are already communications towers in place, was
7 determined to be the most cost-effective option for creating a microwave link
8 between the Green Borders project and the CAISO Controlled Grid. Using the
9 existing communication towers is less expensive than installing additional ones.

10

11 **IV. CONCLUSION**

12 **Q.** Does this conclude your direct testimony?

13 **A.** Yes.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator)
Corporation) Docket No. ER07-1034-002

I, Songzhe Zhu, declare under penalty of perjury, that the foregoing questions and answers labeled as my testimony were prepared by me, with the assistance of others working under my direction and supervision; and that the facts contained in my answers are true and correct to the best of my knowledge, information, and belief.

Executed at Folsom, California, on December 02, 2008



Songzhe Zhu