2012-2013
TRANSMISSION PLAN

California ISO
Shaping a Renewed Future

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3.6 Review of Existing SPS

Within the ISO controlled grid there are a significant number of Special Protection Systems (SPS) in operation. These SPS are related to a wide variety of system operating conditions such as, bulk system performance requirements, local area performance requirements and generator interconnection. As a part of the 2012-2013 Transmission Planning Process (TPP), the ISO conducted an assessment of the existing SPS that are in operation in the ISO Controlled Grid. The objective of the SPS review was to assess the existing SPS that are in operation on the transmission system to ensure that they meet the current needs of the system and as we plan transmission development on the system. The following provides the steps taken in conducting this review of existing SPS.

- Document the list of existing SPS in the ISO controlled grid.
- Identify for each SPS the associated contingency, action initiated, load drop, generation drop, arming, complexity, security, consequences if fail to operate.
- Develop criteria for design and protection coordination review.
- Functional Review of existing SPS.
    - Is functionality current, and does the SPS meet current criteria?
    - Even if so, is the risk of system impact acceptable?

The review of the exiting SPS considered the performance, operation and design of the existing SPS on the system to determine if they need to be modified, removed or replaced due to:

- Planned transmission developments;
- Changes in transmission utilization; and/or
- Changes in risk tolerance.

The review of the existing SPS was done in two stages set out below and was performed under the planning paradigm to supplement the reliability assessment of the ISO controlled grid within the annual TPP:

- Stage-1: Review (Documentation)
- Stage 2: Review (Functional Review)

As part of the annual reliability assessment in the TPP, the ISO performed Stage-1 and Stage-2 reviews for all SPS in each local area. The review of the existing SPS is to develop recommendations of actions, if any, that are required to maintain reliability of the ISO controlled grid and coordination with adjacent interconnected systems.

- leaving the SPS in place as is;
- removing the SPS from service;
- modifying functionality of the existing SPS; or
- replacing the existing SPS with a transmission capital solution.

Table 3.6-1 summarizes the of recommendations for each SPS reviewed as a part of this assessment

Table 3.6-1: Summary of recommendations for each SPS

SPS Name	PTO	Area	Recommendation
Mesa and Santa Maria Undervoltage SPS	PG&E	Central Coast / Los Padres	The need for these two interim SPS solutions prior to the implementation of the approved *New Andrew Project* in 2019 is necessary in order to avoid severe to total voltage collapse conditions in the Mesa 115 kV system under the specified Category C contingency conditions.
Divide Undervoltage SPS	PG&E	Central Coast / Los Padres	The need for this interim SPS solution prior to the implementation of a more permanent solution is necessary in order to avoid severe to total local area-wide voltage collapse conditions in the Divide-Cabrillo-Sisquoc area under the specified Category C contingency conditions.
Temblor-San Luis Obispo 115 kV Overload Scheme (TBD)	PG&E	Central Coast / Los Padres	The need for this SPS is necessary in order to avoid overloading the Temblor-San Luis Obispo 115 kV Line.
COI RAS	PG&E	Bulk	The need for this SPS in future years is evident in order to avoid overloading of facilities in Northern California and Northwest under N-2 contingency conditions and to avoid system collapse. Under some operating conditions, such as low COI and PDCI flow or flow in the opposite (South-to-North) direction, the COI RAS is not required. Under high south-to-north flow, the COI South-to-North RAS is needed.
Colusa SPS	PG&E	Bulk	Colusa SPS may be needed if new renewable generation projects develop in the North Valley area. This SPS may need to be modified to also protect Round Mountain 500/230 kV transformer for the Captain Jack-Olinda outage and for an outage of the Olinda 500/230 kV transformer. It is recommended to leave the SPS in place and to consider its modification if the new generation in the area develops.
Diablo Canyon SPS	PG&E	Bulk	The need for this SPS is clearly evident and hence the recommendation is to have this SPS in-service all the time.

SPS Name	PTO	Area	Recommendation
Gates 500/230 kV Bank #11 SPS	PG&E	Bulk	The need for this SPS is evident and hence the recommendation is to leave it in place.
Midway 500/230 kV Transformer Overload SPS	PG&E	Bulk	The need for this SPS is not clear and hence the recommendation to study other system conditions for which the SPS may be needed. If the SPS appears not to be needed, the recommendation will be to remove it from service.
Path 15 IRAS	PG&E	Bulk	The need for this RAS in future years is evident in order to avoid overloading of PG&E transmission facilities under N-2 contingency conditions. However, it was observed that the RAS may not be required under some operating conditions when the flow on Path 15 is low. Since the Path 15 IRAS is armed according to the nomogram and it was shown to be needed it is recommended to leave the RAS in place as it is.
Path 26 RAS North to South	PG&E	Bulk	The need for the Path 26 RAS in the current and future years is evident in order to avoid overloading of the Midway-Whirlwind 500 kV line under N-2 contingency condition. However, it was observed that the SPS may not be required under all operating conditions; it is required only on peak with high north-to-south Path 26 flow. The RAS is armed according to nomograms; therefore risk of unintended operation is low. It is recommended to leave this RAS in place as it is.
Path 26 RAS South to North	PG&E	Bulk	The need for this RAS in the current and future years is evident in order to avoid overloading of the Midway-Whirlwind 500 kV line under N-2 contingency conditions with high south-to-north flow on Path 26. However, the 2012-2013 Transmission Plan studies did not show the need for this RAS because the level of Path 26 flow was not that high. The RAS may still be needed if the flow on Path 26 is higher, which may be the case in the future when more renewable generation will develop in Southern California. Considering that the risk on unintended consequences of the Path 26 RAS is low and it is armed according to the Path 26 nomogram, it is recommended to leave the Path 26 South-to-North RAS in place as it is.

SPS Name	PTO	Area	Recommendation
Table Mt 500/230 kV Bank #1 SPS	PG&E	Bulk	Even if the need for this SPS under low load and high generation conditions is evident, its operation has unintended consequences of high transient frequency dip which is a violation of the WECC criteria. In addition, the SPS is cut-in manually which cannot prevent for human errors that may result in the SPS operating when it is not required or not operating when it is required. It is recommended to re-evaluate the SPS and consider measures other than tripping Hyatt and Thermalito generation. Possible solutions may be upgrades of the overloaded transmission lines or installation of Distributed FACTS devices to re-distribute power flow and mitigate the overloads. Then, the SPS will not be needed. The Distributed FACTS devices may also help to mitigate overloads in the Table Mountain-Rio Oso area that may occur with a 500 kV double outage south of Table Mountain and eliminate the need for tripping Feather River generation with this contingency. Another solution may be to trip generation other than Hyatt and Thermalito by the SPS to avoid violations of the WECC transient frequency criteria.
Drum (Sierra Pacific) Overload Scheme (Path 24)	PG&E	Central Valley	Although the need for this SPS is not evident based on the results of the 2012-2013 reliability assessment, this SPS could still be needed to protect Drum – Rio Oso #1, Drum – Rio Oso #2, Gold Hill – Placer #1 and Gold Hill – Placer #2 115kV lines during high export to Sierra Pacific and low Drum area generation conditions. More studies are needed to see if there are credible system conditions in Sierra Pacific system that could result in high import into Sierra Pacific given that the network topology changed from the time this SPS was originally designed. As such, the recommendation for this SPS is to leave it in place as is.
Stanislaus – Manteca 115 kV Line Load Limit Scheme	PG&E	Central Valley	The need for this SPS is evident in order to avoid overloading of the Stanislaus-Manteca 115 kV lines under Category C contingency conditions. As such, the recommendation for this SPS is to leave it in place as is.

SPS Name	PTO	Area	Recommendation
Vaca-Suisun 115 kV Lines Thermal Overload Scheme	PG&E	Central Valley	The need for this SPS is evident in order to avoid overloading of the Vaca-Suisun-Jameson 115 kV line under N-1 contingency condition. As such, the recommendation for this SPS is to leave it in place as is.
West Sacramento 115 kV Overload Scheme	PG&E	Central Valley	Although a need for this SPS was not found in any years and scenarios studied for the N-1 contingency condition that this SPS was originally designed for, this SPS could be used to some extent to protect the 115 kV lines in the area under some Category C events until the Vaca-Davis conversion project is implemented. As such, the recommendation for this SPS is to leave it in place as is until the project gets implemented and consider taking this SPS out of service following the transmission upgrade project implementation.
West Sacramento Double Line Outage Load Shedding SPS Scheme	PG&E	Central Valley	The need for this SPS is evident until the Vaca-Davis 115 kV voltage conversion project is implemented. However, the SPS, as designed, is not sufficient to mitigate overload on the Brighton-Davis 115 kV line. As such, the recommendation for this SPS is to modify the design to include tripping of third distribution transformer as well at West Sacramento substation and leave it in place until the transmission upgrade project gets implemented.
Ashlan SPS	PG&E	Greater Fresno Area	The need for this SPS in future years should not be needed once the Gregg-Ashlan 230kV and Herndon-Ashlan 230kV lines are reconductored. Mis-operation of this SPS only causes Ashlan to be single sourced with no other consequences. Keep SPS in place until completion of project to reconductor Gregg-Ashlan 230kV and Herndon-Ashlan 230kV lines.

SPS Name	PTO	Area	Recommendation
Atwater SPS	PG&E	Greater Fresno Area	The need for this SPS is evident and hence the recommendation is to leave it in place until completion of the Wilson 115kV Area Reinforcement project. It is also recommended that the set point to trip Atwater-El Capitan 115kV be reviewed, as it seems too low to prevent exceeding Emergency ratings for the lines noted above.
Gates Bank 11 SPS	PG&E	Greater Fresno Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Helms HTT RAS	PG&E	Greater Fresno Area	The need for this SPS is evident and hence the recommendation is to leave it in place. Further review is necessary to determine why the T-129 PI screen and results above differ. New projects included in the planning base cases may account for the shift.
Helms RAS	PG&E	Greater Fresno Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Henrietta RAS	PG&E	Greater Fresno Area	The need for this SPS is not completely evident and further study is needed. • Can LTCs be locked at Henrietta? • Capital transmission solution to eliminate 230kV taps at Henrietta?
Herndon-Bullard SPS	PG&E	Greater Fresno Area	Per email from ISO and PG&E OE, this SPS was removed when the limiting switches were upgraded.
Kerckhoff 2 RAS	PG&E	Greater Fresno Area	This SPS should be reviewed by protection, since the description says that Kerckhoff #1-Kerckhoff #2 115kV (CB142) is one of the monitored elements. This line is a radial gen-tie between Kerckhoff #1 & Kerckhoff #2. It should probably monitor CB182, which is the Chowchilla-Kerckhoff 2 115kV line. Recommendation is keep this SPS in place to avoid reducing generation by control room personnel during spill conditions.

SPS Name	PTO	Area	Recommendation
Reedley SPS	PG&E	Greater Fresno Area	This SPS needs to be reviewed/updated by Operations Engineering to include the new Sanger-Reedley 115kV line that was converted from 70kV to 115kV in 2012. Substation at Reedley has been sufficiently upgraded that the CB numbers in the SPS document no longer make sense when looking at the one-line.
Metcalf SPS	PG&E	Greater Bay Area	The need for this SPS is not evident based on the conditions studied in the planning assessment. The recommendation is to leave it in place normally cut-out until further study is conducted.
SF RAS	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
South of San Mateo SPS	PG&E	Greater Bay Area	The need is evident until the capacity project is complete.
Metcalf-Monta Vista 230kV OL SPS	PG&E	Greater Bay Area	The need for this SPS is not evident at the time and hence the recommendation is to leave it in place until further study is conducted.
San Mateo-Bay Meadows 115kV line OL	PG&E	Greater Bay Area	The need for this SPS is not evident at the time and hence the recommendation is to leave it in place until further study is conducted.
Moraga-Oakland J 115kV line OL RAS	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Grant 115kV OL SPS	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Oakland 115 kV C-X Cable OL RAS	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Oakland 115kV D-L Cable OL RAS	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Sobrante-Standard Oil #1 & #2-115kV line	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Gilroy SPS	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.

SPS Name	PTO	Area	Recommendation
Transbay Cable Run Back Scheme	PG&E	Greater Bay Area	The need for this SPS is evident and hence the recommendation is to leave it in place.
Humboldt – Trinity 115kV Thermal Overload Scheme	PG&E	Humboldt	Although the need for this SPS does not exist anymore based on the conditions studied in the planning assessment of the Humboldt system, the SPS can be left in service to protect the Humboldt – Trinity 115 kV line against thermal overloads for any system conditions that are not covered under the planning studies.
Caribou Generation 230 kV SPS Scheme #1	PG&E	North Valley	The need for this SPS is evident in order to avoid overloading of the Caribou-Palermo 115 kV line under N-1 contingency condition. As such, the recommendation for this SPS is to leave it in place as is.
Caribou Generation 230 kV SPS Scheme #2	PG&E	North Valley	The need for this SPS is evident in order to avoid instability in Caribou area under N-1 contingency condition. As such, the recommendation for this SPS is to leave it in place as is.
Cascade Thermal Overload Scheme	PG&E	North Valley	The need for this SPS is evident in order to avoid overloading of the Cascade-Benton-Deschute 60 kV line under N-1-1 contingency condition. As such, the recommendation for this SPS is to leave it in place as is.
Hatchet Ridge Thermal Overload Scheme	PG&E	North Valley	The need for this SPS is evident in order to avoid overloading of the Pit #1-Cottonwood 230 kV line under N-1 contingency condition. As such, the recommendation for this SPS is to leave it in place as is.
Coleman Thermal Overload Scheme	PG&E	North Valley	The need for this SPS is evident until the New 230/60 kV substation and new 60 kV lines to Red Bluff and Tyler substations project is implemented in order to avoid overloading of the Coleman-Red Bluff 60 kV line under N-1 contingency condition. As such, the recommendation for this SPS is to leave it in place as is until the project gets implemented and consider taking this SPS out of service following the project implementation.
Antelope-RAS	SCE	Antelope-Bailey	The recommendation for this SPS is to remove the SPS from service.

SPS Name	PTO	Area	Recommendation
Big Creek / San Joaquin Valley RAS	SCE	Big Creek Corridor	The need for this SPS is evident. The current SPS needs modification due to Cross-Valley loop in project. Hence the recommendation is to modify existing SPS.
Bishop RAS	SCE	North of Lugo	The need for this SPS is evident and hence the recommendation is to leave it in place.
High Desert Power Project RAS	SCE	North of Lugo	The need for this SPS is evident for Lugo-Victor No.1 and No.2 220 kV and for Lugo 1AA and 2AA Banks 500/220 kV contingency and hence the recommendation is to leave it in place. For Lugo-Victor No.1 or No.2 220 kV and Lugo 1AA or 2AA Banks 500/220 kV outage; the RAS need was not identified with the given system conditions. Additional study needs to be performed on the cases to verify the need of RAS for Lugo-Victor No.1 or No.2 220 kV and Lugo 1AA or 2AA Banks 500/220 kV contingency.
Kramer RAS	SCE	North of Lugo	The need for this SPS is evident for monitored outages except for Kramer-Lugo No.1 or No.2 220 kV. Also, the current SPS needs modification to maintain stability in the system. Hence the recommendation is to modify existing SPS. For Kramer-Lugo No.1 or No.2 220 kV outage; the RAS need was not identified with the given system conditions. Additional study needs to be performed on the cases to verify the need of RAS for Kramer-Lugo No.1 or No.2 220 kV contingency.
Lancaster N-2 Line Loss Tripping Scheme	SCE	Antelope-Bailey	The need for this SPS is evident and hence the recommendation is to leave it in place.
Palmdale N-2 Line Loss Tripping Scheme	SCE	Antelope-Bailey	The need for this SPS is evident and hence the recommendation is to leave it in place.
Pastoria Energy Facility Existing RAS	SCE	Antelope-Bailey	The need for this SPS is evident and hence the recommendation is to leave it in place.
Reliant Energy Cool Water Stability Tripping Scheme	SCE	North of Lugo	The need for this SPS is evident. The current SPS needs modification to maintain stability in the system. Hence the recommendation is to modify existing SPS.

SPS Name	PTO	Area	Recommendation
West-of-Devers Remedial Action Scheme	SCE	Eastern Area	The WOD RAS was installed as a temporary solution until re-conductoring of the WOD 230 kV lines can be completed. The in-service date of the WOD upgrades is estimated to be in the year 2019. Modifications are needed to this SPS to accommodate new transmission and generation coming on-line prior to 2019.
Blythe Energy RAS - Thermal Overload Scheme	SCE	Eastern Area	The need for this SPS is evident and hence the recommendation is to leave it in place. Operating procedures and flow limits need to be updated to ensure compatibility with the SPS.
Blythe Energy RAS – Low Voltage Scheme	SCE	Eastern Area	The ISO recommends this SPS be removed from service. Flow limits need to be implemented to ensure area voltages and voltage deviations are within limits following an outage of Palo Verde–Colorado River 500 kV line.
Eagle Mountain Thermal Overload Scheme	SCE	Eastern Area	The ISO recommends this SPS be removed from service once flow limits are implemented to ensure the line protected by the SPS remains within its thermal rating following an outage of Palo Verde–Colorado River 500 kV line.
El Nido N-2 Remedial Action Scheme	SCE	Metro Area	The need for this RAS is evident in order to avoid overloading of the remaining 230 kV line under loss of any two of the three monitored 230 kV lines for the Category D contingency of G-1/N-2. It is recommended to leave the RAS in place.
Mountainview Power Project Remedial Action Scheme	SCE	Metro Area	The need for this RAS is evident in 2014 and 2017 under high output of the Mountainview Power Project and low load at the San Bernardino and El Casco Substations. However, the study did not identify the need of the RAS after the West-of-Devers Upgrade Project (re-conductoring of the West-of-Devers 230 kV lines) is completed. This is estimated to be sometime in 2018. In addition, it is recommended that the RAS settings (e.g. arming threshold) be reviewed before the Interim West-of-Devers Project (installing series reactors on the West-of-Devers 230 kV lines) is in service.

SPS Name	PTO	Area	Recommendation
South of Lugo N-2 Remedial Action Scheme	SCE	Metro Area	The need for this RAS is evident before the new Mira Loma-Vincent 500 kV Line is in service. However, the study did not identify the need of the RAS after the new Mira Loma-Vincent 500 kV Line is in service. It is recommended to keep the RAS normally disabled after the Mira Loma-Vincent 500 kV Line is in service and to enable it under critical system conditions. It is also recommended that SCE review and update (if needed) the RAS settings before each of the following transmission upgrades is in place. • Segments of Tehachapi Renewable TransmissionProject (TRTP) in the LA Basin area • Devers-Palo Verde No.2 Project (California portion) • Interim West-of-Devers Project • West-of-Devers Upgrade Project
Mira Loma Low Voltage Load Shedding	SCE	Metro Area	The need for this RAS is evident. It is recommended that the SPS be reviewed and updated before each of the following transmission upgrades are in place. • Segments of Tehachapi Renewable Transmission Project (TRTP) in the LA Basin area • Devers-Palo Verde No.2 Project (California portion) • Interim West-of-Devers Project • West-of-Devers Upgrade Project
Santiago N-2 Remedial Action Scheme	SCE	Metro Area	The need for this RAS is evident under stressed system conditions (e.g. the Category D contingency of N-2 in addition to a forced outage of Huntington Beach Units 1 & 2). It is recommended that the arming threshold of the RAS be reviewed and updated before and after the following upgrades: (a) Barre – Ellis 230 kV Reconfiguration (to four 230 kV lines) and (b) Johanna & Santiago 230kV Capacitor Banks.

SPS Name	PTO	Area	Recommendation
Valley Direct Load Trip Remedial Action Scheme	SCE	Metro Area	The need for the VDLT RAS is not evident in the study. The following major system reinforcements were or will be in place to improve voltage stability in the Valley area after the VDLT RAS was in service. • Valley No.5 and No.6 500 kV shunt capacitors (already in service) • Inland Empire Energy Center (IEEC) (already in service) • Devers-Valley No.2 500 kV Line (estimated in-service date: 2013) It is recommended to normally disable the RAS and to enable it under critical system conditions. In addition, it is needed to modify the monitored transmission lines after the Alberhill Substation is in service.
230kV Otay Mesa Energy Center Generation SPS	SDG&E	SDG&E	The need for this SPS in future years is evident in order to avoid overloading of facilities in CFE under N-2 contingency condition.
ML (Miguel) Bank 80/81 Overload SPS	SDG&E	SDG&E	The need for this SPS is evident under an outage of TL50003 line and hence the recommendation is to activate it when TL5003 is out-of-service.
CFE SPS to protect lines from La Rosita to Tijuana	SDG&E	SDG&E	The need for this SPS in future years is evident in order to avoid overloading of facilities in CFE under N-2 contingency (TL50001 and TL50003) and any other conditions which can result in overloads on CFE internal system.
TL 50001 IV Generator SPS	SDG&E	SDG&E	The need for this SPS is evident under an outage of TL50003 line and hence the recommendation is to activate it when TL5003 is out-of-service.
Path 44 South of SONGS Safety Net	SDG&E	SDG&E	This scheme would prevent voltage collapse caused by extreme (Category D) contingencies by shedding up to 800 MW load. The need for such a scheme is evident in all study years.