Southern California Seismic Network and Earthquake Data Center Continuity Plan

CERTIFICATION

I, the undersigned, on this date have reviewed and acknowledge that this Continuity of Operations Plan is an integral part of the overall emergency response and recovery of the Southern California Seismic Network, and that this plan will be activated in the event the SCSN has been affected as a result of an emergency event.

_____ _____

Date

Change History

Version	Change Description	Modified By	Date
0.1	Original Draft Outline	Ellen Yu	3/27/08
0.2	Incorporate feedback from K. Hutton and E. Hauksson	Ellen Yu	3/28/08
0.3	Feedback from R. Bhadha, S. Schwarz and R. Yip re: Service level matrix. Added service level templates for RT, PP, DC services	Ellen Yu	5/01/08
0.4	Feedback from D. Given, K Hutton – revised recovery tier and disruption level definitions	EllenYu	5/08/08
0.5	Entered feedback from R. Bhadha, S. Schwarz, and R. Yip for SLO's for Event detection	Ellen Yu	5/16/08
0.6	Entered feedback from D. Given, revised SLO's for data archive	Ellen Yu	5/23/08
0.7	Entered feedback from R. Bhadha, S. Schwarz, and R. Yip for SLO's for RT Data Exchange and Waveform acquisition	Ellen Yu	6/12/08
0.8	Entered feedback from B. Flagg re: ShakeMap	Ellen Yu	6/17/08
0.9	Entered sections "Mission Essential", "Vital Systems", "Essential Personnel", "Points of Contact", and "Restoration of Function"	Ellen Yu	7/10/08
1.0	Revised Restoration of Function section, added "Outside Reference Personnel (section 7)	Ellen Yu	7/21/08
1.1	Revisions to most sections, including addition of earthquake early warning (EEW) operations	Jen Andrews	8/19/16

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1.0 Introduction

1.1 Purpose

The purpose of this document is description of an executable plan for providing Southern California Seismic Network (SCSN) and Southern California Earthquake Data Center (SCEDC) continuity in the event of a disruption. This plan shall address all aspects (e.g., hardware, software, data, people, procedures, facilities, communication, etc.) required for recovery from minor to major disruption of services provided by SCSN and SCEDC.

On an annual basis, this plan shall be reviewed and updated by SCSN/SCEDC staff.

Please also reference the broader Caltech Business Continuity or Disaster Recovery Plan as described in TBD document that addresses non-SCSN/SCEDC provided functions or services.

1.2 Mission-Essential Services of SCSN/SCEDC

The Southern California Seismic Network (SCSN) and the Southern California Earthquake Data Center (SCEDC), are the primary source of earthquake information for southern California. The SCSN is part of CISN (California Integrated Seismic Network), a cooperative project between the USGS, Caltech, the California Geological Survey (CGS) and UC Berkeley to operate seismic networks, analyze data, and notify the public, media, and emergency responders. The SCSN is part of the Advanced National Seismic System (ANSS), the nationwide seismic monitoring collaboration. SCSN is also a crucial part of the prototype Earthquake Early Warning (EEW) system for California, both through the delivery of seismic data into the system, and as a key component of the data processing and alert dissemination.

The network contains more than 400 remote seismometers in southern California. Signals from the SCSN sites are telemetered to a central processing location at the Caltech Seismological Lab in Pasadena. Computers running software that detects and records thousands of earthquakes each year continuously monitor these signals. Phase arrival times for these events are picked automatically and reviewed by analysts, and are archived along with digital seismograms. Data acquisition, processing and archiving is achieved using the CISN system. These data have been compiled into the SCSN Catalog of Earthquakes; a list beginning in 1932 that currently contains more than 600,000 events. Waveform, phase, and catalog data are archived by the Southern California Earthquake Data Center (SCEDC). This data set is critical to the evaluation of earthquake hazards in California and to the advancement of geoscience as a whole.

Essential functions are:

- Acquiring seismic waveforms from the field.
- Detecting seismic events and determining a hypocenter, magnitude and origin time in real time.
- Generating a moment tensor for events above magnitude 3 in real time.
- Producing a “ShakeMap” for events above magnitude 3 in real time.
- Exchanging waveforms, amplitudes, phase picks and strong motion event records with other ANSS networks.
- Providing analyst review of earthquakes.
- Providing a moment tensor reviewed by analysts.

- Notifying outside agencies of detected events.
- Archiving waveforms and catalog of events detected by SCSN.
- Distributing archived waveforms and event catalog for scientific research.
- Archiving the metadata of the stations that comprise the SCSN and distribute them for scientific research.
- Delivering seismic waveforms into the EEW system with low latency.
- Running EEW processing software and contributing alerts to the prototype system.

1.3 Potential Causes of Disruption

The following list of potential disruptions is not exhaustive.

1.3.1 Environmental Disasters

- High Winds
- Flood
- Drought
- Earthquake
- Electrical storms
- Fire
- Landslides
- Freezing or High Heat Conditions
- Contamination and Environmental Hazards
- Epidemic

1.3.2 Organized and/or Deliberate Disruption

- Act of Terrorism
- Act of Sabotage
- Act of war
- Theft
- Arson
- Labor Disputes

1.3.3 Loss of Utilities and Services

- Electrical power failure
- Loss of gas supply
- Loss of water supply
- Petroleum and oil shortage

- Communications services breakdown
- Loss of drainage / waste removal

1.3.4 Equipment or System Failure

- Internal power failure
- Air conditioning failure
- Equipment failure

1.3.5 Serious Information Security Incidents

- Cyber crime
- Loss of records or data
- Disclosure of sensitive information
- IT system failure

1.3.6 Other Emergency Situations

- Workplace accident (laboratory accident/gas leaks)
- Workplace violence
- Public transportation disruption
- Neighborhood hazard
- Health and Safety Regulations
- Employee morale
- Negative publicity
- Legal problems

2.0 General Description of Protection of Vital Systems, and Equipment and Records

Strategy to insure continuity of essential functions has several parts. First, data acquisition, processing, and notification functions are automated and require no human intervention. Second, critical functions are performed by two redundant systems and single points of failure are minimized to insure operation through failures. Third, diverse telemetry paths (including cell modem, radio, microwave) are used to insure reception of at least some data. Finally, in the event that all systems fail in Pasadena or information cannot be communicated to critical users, both the Northern California Seismic Network (NCSN) in Menlo Park, Ca. and the National Earthquake Information Center (NEIC) in Golden, Co. can produce and disseminate lower quality, backup information.

2.1 Main Locations

Equipment:

- South Mudd Building, Caltech
    - 2nd floor computer room
    - 4th floor communications equipment and computers
    - Roof communications equipment
- 525 S Wilson Ave. (yellow house), USGS Pasadena
    - Basement communications equipment and computers
    - 1st floor computers
- Conduit for communications between buildings (beneath Wilson Avenue)

Offices for personnel and other less critical infrastructure are located in South Mudd Building, Caltech, 525 S Wilson Ave., USGS Pasadena and 535 S Wilson Ave., USGS Pasadena. This includes space in the sub-basement, basement, 2nd and 4th floors of South Mudd, plus basement, 1st and 2nd floors in 525 and 535 S Wilson Ave.

2.2 Vital Systems and Equipment

The SCSN includes seismic instrumentation at approximately 400 remote sites in southern California and the supporting telemetry infrastructure. Some of this telemetry is owned and operated by other organizations and is beyond our control. Diverse telemetry paths are used so that loss of a portion of this network would impair but not prevent critical functions. Remote hub telemetry sites have backup power and redundant components. Individual digital stations have backup power systems.

The SCSN data processing center includes telemetry equipment, computers, networking equipment, and the supporting infrastructure. This equipment is housed on the second floor of the South Mudd building of Caltech. All critical systems have redundant hot backups (section 10.1). Spares for some critical components are available on site. In the event of unrecoverable loss of essential equipment, the SCSN/SCEDC would need to purchase replacement equipment. All hardware components are off-the-shelf and readily available from commercial sources. Some components could be borrowed from other seismic networks. Critical software is backed up on disk and magnetic tape. Repository and configuration management tools are used and regularly exercised to insure rapid and reliable recreation of processing environments, configurations and software. As currently configured all critical functions of the SCSN could be performed in the absence of the SCEDC archive.

In the unlikely event of a catastrophic failure that prevented the SCSN from reporting an important earthquake, information would be provided to our customers by the NCSN or NEIC.

In the worst case scenario, critical systems would need to be replaced. A list of the hardware and software components necessary to resume essential functions is in Appendix A. It would probably take about two weeks to resume operations from scratch.

The USGS Pasadena office houses and supports hardware that is part of the USGS Earthquake Notification System. Additional redundant servers exist at other USGS locations. These systems are on UPS power and are connected to the building backup generator. Systems should automatically switch to using back-up power in the case of mains being unavailable. Backup diesel generators support all circuits, providing approximately 12 hours of power from full fuel tanks.

A T1 DOInet link provides a completely independent Internet route to the outside. The Pasadena office is connected to CISN partners via a dedicated T1 ring that provides automatic failover of center-to-center IP traffic in the event of a major Internet outage. For a detailed listing of the level

of redundancy for each mission essential service at a certain disruption severity level, please see the section titled “Service Level Objectives” in this document.

Hardware on site at both Caltech and USGS Pasadena forms part of the prototype EEW system. These servers are part of a design with redundant components in northern California (UC Berkeley and USGS Menlo Park). Critical software is backed up using repositories.

2.3 Vital Records

Historical and current waveform data are archived on a RAID system run by the Southern California Earthquake Center Data Center (SCEDC). This system contains earthquake locations, parametric data, and seismograms for southern California earthquakes from 1932 to present. This archive contains more than 600,000 earthquakes. The system is backed up on a regular schedule.

Historical data are also stored on disks and backup tapes. Copies of the most recent database backup tapes are also sent to the Northern California Earthquake Data Center for offsite storage. Continuous waveforms from a subset of stations are archived to the IRIS data center in Seattle, WA. Disk copies of the waveform archive are also stored at Albuquerque Seismological Laboratory. For a detailed listing of the level of redundancy for each mission essential service at a certain disruption severity level, please see the section titled “Service Level Objectives” in this document.

3.0 Restoration of Function

Restoration of function will have three phases:

I. Immediate Response to Emergency

The first order of business is to insure the safety of personnel and to minimize loss of property. All safety directives from the Institute take precedence.

A. Meeting Place

All essential personnel have been instructed to report to the Media Center on the second floor of S. Mudd after any emergency. If this facility is not available, the meeting place is the USGS conference room in 525 S. Wilson.

B. Succession of Authority for SCSN/SCEDC Operations

Please see section 5 of this document.

C. Staff Communication

Supervisors will be responsible for communicating with their team in the threat of and/or aftermath of an emergency. Employees will be encouraged to check-in with their supervisor after an emergency. Availability of each member of the “SCSN/SCEDC Essential Personnel” (section 6.0) will be determined. As needed, we will:

1. Conduct office-by-office searches, if possible
2. Contact employees or their families at home through the management team

II. Interim Restoration of Essential Function

The next priority would be to assess and initiate steps to secure an alternate site and procure replacement equipment and software. As discussed above, if the damage to local facilities was serious, limited, temporary function could be resumed by redirecting data signals to

Menlo Park. SCSN personnel would be rotated into Menlo Park to support reporting of southern California earthquakes.

In case of a significant earthquake, the following important operations would be assigned to personnel according the succession and delegation of authority table:

Field operations: maintain the seismic monitoring network, restoring critical telemetry as needed and facilitating data recovery as needed. SCSN personnel may be deployed to install temporary seismic stations to enhance recording of aftershocks.

Analysis/response: Duty Seismologist or designated personnel completes Duty Seismologist checklist (http://rift.gps.caltech.edu/duty/dutychk.html). Seismologists, analysts and/or designated personnel locate seismic events based on significance, provide web site updates as necessary.

Data center: continue monitoring critical and key systems, taking proactive steps to avoid downtime.

III. Restoration of Full Function

The final stage would be to arrange for permanent repair or replacement of shop and office space and necessary equipment.

4.0 Communications, Warning and Notification

The primary means of notification is telephone. Cell phones are available and may perform better in some emergencies. Notification can also be sent by SMS, e-mail, and the Internet. If the emergency is related to earthquakes, personnel may also be alerted by the news media and by felt ground motion.

The State of California's satellite based telephone system (OASIS) is available at both South Mudd and 525 South Wilson. Several Iridium satellite phones are also available.

A DOInet connection gives us an Internet link to the Menlo Park office independent of the Caltech Internet connections.

All USGS buildings have a fire and burglar alarm system. In the event of a fire, power failure, or unauthorized entry, the Caltech Security Office would notify key USGS personnel.

There is a 24-hour on-call "duty seismologist" who is notified automatically by the real-time processing software of all potentially damaging earthquakes. They carry a cellular web-enabled device and have phone and pager numbers to notify additional personnel if necessary.

We have automated systems that monitor the status of critical telemetry points that may affect the performance of the overall system. Email or SMS notifications are sent to personnel based on the significance of the outage. We also have automated systems that monitor the health of critical servers that may impact the performance of our regular duties and these systems page the computer or network system administration personnel based on the significance of the outage using email or SMS.

Several monitoring and notification systems are set up to assess state of health of critical operations and issue automatic alerts. This includes monitoring of:

- station and telemetry performance,
- physical and performance status of hardware,
- checks on critical software operations.

Alerts are sent to personnel responsible for the relevant component, with redundancy for additional alerts to be issued if the problem is not acknowledged and/or resolved.

5.0 Succession and Delegation of Authority

It is within the authority of SCSN manager or Successors (if SCSN Manager is not available) listed below to make decisions on relocating essential functions and personnel, procuring replacement equipment, and prioritization of work and the order in which that personnel return to work.

SCSN	**Name/Title**	**Email Address**	**Office Phone**
Manager (USGS)	Valerie Thomas	vthomas@usgs.gov	626-583-7820
Manager (Caltech)	Egill Hauksson	hauksson@gps.caltech.edu	626-395-6954
	Rayo Bhadha	rayo@gps.caltech.edu	626-395-2407
	Ellen Yu	eyu@gps.caltech.edu	626-395-8122
	Jen Andrews	jrand@gps.caltech.edu	626-395-4621
	Alberto Devora	alberto@gps.caltech.edu	626-395-2676

Procurement (USGS)	**Name/Title**	**Email Address**	**Office Phone**
Primary Procurement	Valerie Thomas	vthomas@usgs.gov	626-583-7820
	Doug Given	doug@usgs.gov	626-583-7812
	Elizabeth Cochran	ecochran@usgs.gov	626-583-7238

Procurement (Caltech)	**Name/Title**	**Email Address**	**Office Phone**
Primary Procurement	Egill Hauksson	hauksson@gps.caltech.edu	626-395-6954
	Rob Clayton	clay@gps.caltech.edu	626-395-6909
	Rayo Bhadha	rayo@gps.caltech.edu	626-395-2407
	Alberto Devora	alberto@gps.caltech.edu	626-395-2676
	Mike Gurnis	gurnis@gps.caltech.edu	626-395-6979

6.0 Essential Personnel (alphabetical)

Name	Email Address	Contact #'s	Position
Prabha Acharya	pacharya@gps.caltech.edu	O: 626-395-2106	SCEDC
Marcos Alvarez	malvarez@usgs.gov	O: 626-768-1009 M: 626-32-1844	Field Team Leader (USGS)
Jennifer Andrews	jrand@gps.caltech.edu	O: 626-395-4621 M: 626-757-9748	Staff Seismologist
Rayo Bhadha	rayo@gps.caltech.edu	O: 626-395-2407 M: 626-298-9809	SCSN Technical Manager
Aparna Bhaskaran	aparnab@gps.caltech.edu	O: 626-395-8018 M: 805-231-1718	DC/RT database administrator SCEDC/SCSN products
Mike Black	mlb@gps.caltech.edu	O: 626-395-6944 H: 626-614-9177 M: 626-658-6025	RT systems administrator
Chris Bruton	cpbruton@gps.caltech.edu	O: 626-395-6915 M: 907-699-1916	Research Engineer
Shang-Lin Chen	schen@gps.caltech.edu	O: 626-395-5708 H: 626-578-0712 M: 626-372-9114	DC system administrator, data archivist, programmer
Rob Clayton	clay@gps.caltech.edu	O: 626-395-6909 H: 626-798-8365	SCEDC
Alberto Devora	alberto@gps.caltech.edu	O: 626-395-2676 H: 626-357-6851 M: 626-827-5080	Sr. Instrumentation Specialist
Claude Felizardo	claude@gps.caltech.edu	O: 626-395-8582 M: 626-390-0462	EEW programmer
Gary Gann	agann@usgs.gov	O: 626-583-6803 M: 678-453-6852	Postprocessing developer (USGS)
Doug Given	given@gps.caltech.edu	O: 626-583-7812 H: 818-541-1952 M: 626-216-6008	Geophysicist Earthquake Early Warning Coordinator
Mike Gurnis	gurnis@gps.caltech.edu	O: 626-395-6979	Director, Caltech Seismological Lab

Name	Email Address	Contact #'s	Position
Garret Hartman	ghartman@gps.caltech.edu	O: 626-395-6959	EEW programmer
Egill Hauksson	hauksson@gps.caltech.edu	O: 626-395-6954 H: 818-790-4009 M: 626-255-0323	Sr. Research Associate in Geophysics
Zack Newman	znewman@gps.caltech.edu	O: 626-395-6929 M:	Seismic Analyst
Nick Scheckel	nick@gps.caltech.edu	O: 626-395-6955 H: 626-396-4922 M: 626-379-6071	Sr. Seismic Analyst/ CISN Display Systems Analyst
Stan Schwarz	stan@bort.gps.caltech.edu	O: 626-583-7231 H: 626-296-1216 M: 626-394-9010	RT systems administrator
Igor Stubailo	stubailo@gps.caltech.edu	O: 626-395-6941 M: 626-318-2022	Research Engineer
Valerie Thomas	vthomas@usgs.gov	O: 626-583-7820 H: 424-227-6543 M: 626-646-3898	SCSN Manager (USGS)
Mike Watkins	watkins@gps.caltech.edu	O: 626-395-2597 H: 626-535-9737 M: 626-827-5062	Seismic Network Field Engineer
Ellen Yu	eyu@gps.caltech.edu	O: 626-395-8122 H: 626-844-1859 M: 949-887-2229	Product Manager SCEDC/SCSN products

7.0 Outside Reference Personnel

Name	Email Address	Office Phone
Paul Friberg	p.friberg@isti.com	845-256-9290
Stephane Zuzlewski	stephane@seismo.berkeley.edu	510-642-0073
Pete Lombard	lombard@seismo.berkeley.edu	510-642-0073

8.0 Points of contact

Function	Organization	Name	Phone number
Backup earthquake reporting	NEIC	Person on-call	(303) 273-8500
Backup earthquake reporting	NCSN	Lind S. Gee	(650) 329-5656
Notification/support	Caltech Seismo Lab	Egill Hauksson	(626) 255-0323
Notification	CGS	Tony Shakel	(916) 322-7481
Notification	SCEDC	Rob Clayton	(626) 395-6909
Security	Caltech Security		(626) 395-5000
Fire suppression/medical	Pasadena Fire Dept.		911 or (626) 405-4655
Security	Pasadena Police		911 or (626) 405-4501
Property Repair	Caltech Prop. Mgmt.		(626) 395-3457
Electrical power - So.Mudd	Caltech Phys. Plant		(626) 395-4717
Electrical power - Wilson	City of Pasadena		(626) 744-4673
Water service	City of Pasadena		(626) 744-4138
Telephone services	FTS		(800) 775-2006
Internet connection-USGS	USGS	Stan Schwarz	(626) 583-7231
Internet connection-Caltech	Caltech IMSS	Help Desk	(636) 395-3500
Internet connection-DOInet	USGS Menlo Park	Pat Murphy	(650) 329-4044
Media Relations	Caltech PR		(626) 395-6326
Media	KNX news radio	Editor desk	(213) 460-3781
Media	KFWB news radio	Editor desk	(213) 871-4688

9.0 Training and Exercises

This plan will be distributed to all SCSN/SCEDC personnel and discussed at a staff meeting. An exercise will be scheduled at least semi-annually to test the plan. Results of each exercise will be evaluated and incorporated into revisions of this plan. A successful COO test will include successful completion of the following:

- Accounting for location of all essential personnel.
- Switchover from primary to backup earthquake processing systems.
- Switchover from primary to backup earthquake notification systems.
- Startup and run of emergency generators.
- Test of OASIS satellite telephone.
- Test of alternate Internet access via DOInet.
- Test of alternate Internet access via CISN ring.
- Location and identification of software backup tapes.

Monitoring tools and communication paths are regularly exercised as part of normal SCSN operations. Additionally a test email is sent each week, and operations are regularly (frequency of weeks to a few months) transferred between redundant systems.

10.0 Definitions

10.1 Fail Over Configurations

10.1.1 Hot Stand-By

Hot Stand-By is a method of redundancy in which primary and secondary (i.e., backup) systems run simultaneously. Data is mirrored to a secondary server(s) in real time so that both systems contain identical information.

10.1.2 Warm Stand-By

Warm Stand-By is a method of redundancy in which the secondary (i.e., backup) system runs in the background of the primary system. Data is mirrored to the secondary server at regular intervals, which means that there are times when both servers do not contain the exact same data.

10.1.3 Cold Stand-By

Cold Stand-By is a method of redundancy in which the secondary (i.e., backup) system is only called upon when the primary system fails. The system on cold standby receives scheduled data backups, but less frequently than a warm standby. Cold standby systems are generally used for non-critical applications or in cases where data is changed infrequently.

10.1.4 Tape Backup

The term “Tape Backup” is applied to any media for data storage whether they are physical tapes, virtual tape libraries or disks. The main criterion is that data on such media can be stored in offsite locations.

10.1.5 Disk Image

Disk image is a computer file containing the complete contents and structure of a data storage medium or device (e.g., hard drive, CD, DVD, etc). The term has been generalized to cover any such file, whether originated from an actual physical storage device or not. As such, a disk image contains all information necessary to replicate the structure and contents layout, as well as the actual contents, of a storage device. This is the distinguishing feature between an ordinary backup and a disk image. A disk image file is usually created based upon the sectors on the medium, ignoring its file system.

Image backup and restore of system volumes will ensure that application and operating system configurations are maintained.

10.2 Levels of Disruption

Level D1: Minor Event - only one real time site (a.k.a. one side of the street) is affected.

Level D2: Major Event - both RT sites affected; key personnel present.

Level D3: Major Event - both RT sites affected; key personnel present, however, access or arrival of critical hardware/software/network resources is degraded or nonexistent (> 24 hrs?).

Level D4: Major Event - both RT sites affected; access or arrival of ALL resources (key personnel, hardware etc.) is degraded or nonexistent (> 24 hrs?).

10.2.1 Examples of Disruption Levels

Level D1

- Disk failure on a RT server on S. Wilson side.
- Air conditioning in telemetry room in S. Mudd goes down.

Level D2

- While one RT database was offline for maintenance, the other fails due to a disk failure.

Level D3

- Large campus fire occurs affecting several buildings including S. Mudd and 525 S. Wilson.

Level D4

- M 6.5 occurs in the Cucamonga fault zone. Severe shaking damages both telemetry rooms in S. Mudd and 525 S. Wilson. 90% of personnel unable to report to work due to lack of access (network outage and road blocks) or injury.

10.3 Tiers of Recovery

An overview of recovery tiers is illustrated in the matrix below. Specific definitions of each tier follows.

	Backup to storage media	Hot Stand-By	Manual intervention required
Tier 0			**N/A**
Tier 1	**N/A**	**X (from another agency)**	**?**
Tier 2	**X**		**Y**
Tier 3	**X**	**X**	**Y**
Tier 4	**X**	**X**	**N**

Tier 0: No Backup of Data

There is no saved information, no documentation, no backup hardware, and no contingency plan. The time necessary to recover in this instance is unpredictable. In fact, it may not be possible to recover at all. It is highly likely that no data recovery is possible.

Tier 1: Outside Agency provides service

Another agency such as NEIC or the NCSN steps in to provide these services to the public.

Tier 2: Backup to storage media only

Tier 2 offers back up of data and sending these backups to near-by and off-site storage facilities. Depending on how often backups are created and shipped, organizations must be prepared to accept several days to a week of data loss, but their backups are secure off-site. However, this tier lacks the systems on which to restore data for major disruption events.

Tier 3: Tape Backup and Hot Stand-By

Tier 3 offers Tier 2 Backups and near-by or off-site hardware systems that are available to restore data on Hot Stand-By environment. Hot Stand-By (i.e., backup) systems run simultaneously.

Data is mirrored to secondary server(s) in real time so that both systems contain identical information.

Manual (human) intervention required.

Tier 4: Hot standby; no manual intervention required

Tier 4 has a hot standby that will resume functions without human intervention if the primary system becomes unavailable.

10.4 Service Level Objectives

Service Level Objectives are defined minimum performance measures at or above which the service delivered is considered acceptable.

SLOs formally specify end-user expectation about solutions and tolerances. It is a collection of service level requirements that have been negotiated and mutually agreed upon by information providers and information consumers.

SCSN/SCEDC SLOs should include Recovery Time and Recovery Point Objectives based on the criticality of the function/data/system and the Level of Disruption (i.e., from minor outages to major catastrophes affecting large geographic regions).

10.5 Recovery Time Objective

Recovery Time Objective is the time goal for the re-establishment and recovery of business function or resource.

10.6 Recovery Point Objective

Recovery Point Objective is the point in time to which data must be restored in order to resume processing transactions.

11.0 SCSN/SCEDC Continuity Tiers of Service

11.1 Service Restoration

For Tier 2: Restore from the latest backup Disk Image or Files

For Tier 3: Fail over to hot backup site

11.2 Tier 0 – No Backup

11.3 Tier 1 – Backup Only

11.3.1 Backup Storage Locations

Onsite: NAS (network access storage) disks

Offsite: Northern California backup server

11.3.2 Backup Schedules and Process

Backup Rotation and Retention

Onsite Backup Documentation

Offsite Backup Documentation

11.4 Tier 2 – Backup and Hot Stand-By

Tier 2 Recovery includes backup process described in Tier 1

11.4.1 Hot Stand-By Locations

525 S. Wilson Ave

Onsite Locations

- Primary: S. Mudd
- Secondary: 525 S. Wilson Ave

Remote Offsite Locations

- NCSN

11.4.2 Hot Stand-By Fail-Over Process

TBD

12.0 Service Level Objectives Template

12.1 Matrix mapping RTO/RPO for each Disruption Level based on Recovery Tier.

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Function 1 (e.g., RT event declaration)	MC	D1				
	MC	D2				
	MC	D3				
	MC	D4				

Criticality should be based on the categories below.

- **MC:** Mission Critical or Critical Functions
- **Vital:** Essential Functions
- **Important:** Necessary Functions
- **Minor:** Desirable Functions

For each function identified in the matrix, identify and describe components necessary to support this function. Components include Hardware, Software, Data, People, Procedures, Facilities, Communication and Legal.

Operational monitoring thresholds should also be defined at the hardware and application level. These operational thresholds will alert on disruptions and also trigger automatic failover, where applicable.

12.2 Hardware

Hardware systems should include DEV, QA and PROD environments. Please also identify Recovery Tiers for each environment. For example, Tier 1 for DEV and QA; Tier 2 for PROD.

12.3 Software

Software should include DEV, QA and PROD environments. Software components include the following.

- OS
- COTS Software (e.g., web servers, databases, etc)
- SCSN/SCEDC Applications
- Development or deployment tools (e.g., delivery scripts, configuration files, job schedulers, etc)

12.4 Data – Business Critical and Non-Business Critical in DEV, QA and PROD

Data should include both Business Critical and Non-Business Critical data sets in DEV, QA and PROD. Data components include the following.

- User account information and encrypted passwords
- User data
- Application data (e.g., meta information, help info, logs, etc)

12.5 People

People should include key stakeholders (e.g., process owners, users, production support staff, etc.) to notify. The group of people to notify may be different for different Disruption Levels.

12.6 Procedures

Include documentation for installing, configuring and operating. Procedures should also include versions of OS, COTS, etc.

12.7 Facilities

- Power
- Cooling

- Network
- Phone Service
- Access

12.8 Communication

Include description of communication plan when function is disrupted (i.e., who, how and when to contact with example of what to include in communication). Should also identify who is responsible for issuing communication.

In addition to the communication plan specific to disruptions in SCSN/SCEDC provided services, Disruption Level 3, 4 or 5 events should follow Caltech's Business Continuity or Disaster Recovery Communication Plan as described in TBD document.

12.9 Legal

Include any legal contracts that help in operations (e.g., service agreements, help desk support and call numbers, etc.).

13.0 SCSN/SCEDC Supported Applications and Services

These services are based on ANSS Performance Standards document.

13.1 Real Time Systems

13.1.1 Waveform acquisition

13.1.2 Event Declaration

Hypocenter

Magnitude

Origin Time

13.1.3 Moment Tensor

13.1.4 Data Exchange between ANSS Networks

Waveforms

Amplitudes (Not implemented yet)

Phase Picks

Strong Motion Event Records

13.2 Post Processing Systems

13.2.1 Analyst Reviewed Events

Hypocenter

Magnitude

Origin Time

13.2.2 Data Exchange

Ground motion exchange

Event strong motion records

13.2.3 Moment Tensor

13.2.4 ShakeMap

13.3 Data Archival and Public Distribution

Waveforms

Event Bulletin

Metadata

Special Report: not part of ANSS performance standards, but special reports (posted on www.scsn.org) are one main way the SCSN communicates details of an earthquake beyond the standard products. www.scsn.org is cloud-hosted, making it resilient to local disruption, but upload of content requires local hardware and networking capability as well as personnel.

14.0 Service Level Objectives

14.1 Matrix mapping RTO/RPO for each Disruption Level based on Recovery Tier.

14.2 Levels of Disruption

Level D1: Minor Event - only one real time site (a.k.a. one side of the street) is affected.

Level D2: Major Event - both RT sites affected; key personnel present.

Level D3: Major Event - both RT sites affected; key personnel present, however, access or arrival of critical hardware/software/network resources is degraded or nonexistent (> 24 hrs?).

Level D4: Major Event - both RT sites affected; access or arrival of ALL resources (key personnel, hardware etc.) is degraded or nonexistent (> 24 hrs?).

14.3 Tiers of Recovery

An overview of recovery tiers is illustrated in the matrix below. Specific definitions of each tier follows.

	Backup on storage media	Hot Stand-By	Failover mode
Tier 0			
Tier 1	**N/A**	**X (from another agency)**	
Tier 2	**X**		**manual**
Tier 3	**X**	**X**	**manual**
Tier 4	**X**	**X**	**automatic**

14.4 Function 1a: RT Waveform acquisition – CS Import

Function	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT Waveform acquisition CS Import	Mission Critical	D1	Tier 3 - *untested*	Tier 3	45 min	Point of failure
RT Waveform acquisition CS Import	Mission Critical	D2	Tier 0	Tier 2	24 hrs	Point of failure
RT Waveform acquisition CS Import	Mission Critical	D3	Tier 0	Tier 2	Outage time + 24 hrs	Point of failure*
RT Waveform acquisition CS Import	Mission Critical	D4	Tier 0	Tier 2	Outage time + 2 wks	0†

14.5 Function 1b: RT Waveform acquisition – Import

Function	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT Waveform acquisition	Mission Critical	D1	Tier 3*	Tier 3	5 min	Point of failure

* Limited by buffer capacity

† If outage time is exceedingly long, prioritization may be more to resuming service than retrieving lost data.

Function	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Import					Magma- 60 min	
RT Waveform acquisition Import	Mission Critical	D2	Tier 0	Tier 2	24 hrs	Point of failure
RT Waveform acquisition Import	Mission Critical	D3	Tier 0	Tier 2	Outage time + 24 hrs	Point of failure†
RT Waveform acquisition Import	Mission Critical	D4	Tier 0	Tier 2	Outage time + 2 wks	0†

14.6 Function 2: RT Event Detection: Hypocenter, Magnitude, Origin Time

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT Event Declaration	Mission Critical	D1	Tier 4	Tier 4	0	0
RT Event Declaration	Mission Critical	D2	Tier 1/Tier 0	Tier 2	24 hours	0
RT Event Declaration	Mission Critical	D3	Tier 1/Tier 0	Tier 2	Outage time + 24 hrs	0
RT Event Declaration	Mission Critical	D4	Tier 1/Tier 0	Tier 2	Outage time + 2 wks	0

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* Magma is not redundant

† Limited by Earthworm ring buffer capacity

14.7 Function 3: RT Moment Tensor

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT Moment Tensor		D1	Tier 3	Tier 3	0	0
RT Moment Tensor		D2	Tier 1/Tier 0	Tier 2	4 hrs	0
RT Moment Tensor		D3	Tier 1/Tier 0	Tier 2	Outage time + 24 hrs	0
RT Moment Tensor		D4	Tier 1/Tier 0	Tier 2	Outage time + 2 wks	0

14.8 Function 4: RT Data Exchange Between Networks - Waveforms

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT Data Exchange -wfs		D1	Tier 4	Tier 4	0	0
RT Data Exchange -wfs		D2	Tier 2	Tier 2	48 hrs	0
RT Data Exchange -wfs		D3	Tier 2	Tier 2	Outage time + 24 hrs	0
RT Data Exchange -wfs		D4	Tier 2	Tier 2	Outage time + 2 wks	0

14.9 Function 5: RT Data Exchange Between Networks - Phase Picks

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT Data Exchange -picks		D1	Tier 4	Tier 4	0	0
RT Data Exchange -picks		D2	Tier 0	Tier 2	24 hrs	0
RT Data Exchange -picks		D3	Tier 0	Tier 2	Outage time + 24 hrs	0
RT Data Exchange -picks		D4	Tier 0	Tier 2	Outage time + 2 wks	0

14.10 Function 6: RT – Notification (PDL notification, ShakeMap alarm, internal notification)

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT/Post Proc – Notification		D1	Tier 3? (Rayo check)	Tier 4	10 min after detection of problem	0
RT/Post Proc – Notification		D2	Tier 0	Tier 2	24 hrs	0
RT/Post Proc – Notification		D3	Tier 0	Tier 2	Outage time + 1 hr	0
RT/Post Proc – Notification		D4	Tier 0	Tier 2	Outage time +2 wks	0

14.11 Function 7: Post Processing – Analyst Event Review (Hypocenter, Magnitude, Origin Time)

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Analyst Event Review		D1	Tier 4	Tier 4	0	Point of failure
Analyst Event Review		D2	Tier 4	Tier 4	0	Point of failure
Analyst Event Review		D3	Tier 4	Tier 4	0	Point of failure
Analyst Event Review		D4	Tier 1	Tier 1	0	Point of failure

14.12 Function 8: Post Processing – ShakeMap

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
ShakeMap		D1	Tier 3	Tier 4	0	Point of failure
ShakeMap		D2	Tier 1/Tier 2	Tier 1/Tier 2	24 hours	Point of failure
ShakeMap		D3	Tier 1/Tier 2	Tier 1/Tier 2	Outage time + 24 hrs	Point of failure
ShakeMap		D4	Tier 1/Tier 2	Tier 1/Tier 2	Outage time + 2 wks	Point of failure

14.13 Function 9: Post Processing – Data Exchange Between Networks – Event Strong Motion Records

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Event Strong Motion Records		D1	Tier 2	Tier 2	48 hours	Point of failure
Event Strong Motion Records		D2	Tier 2	Tier 2	48 hours	Point of failure
Event Strong Motion Records		D3	Tier 2	Tier 2	Outage time + 48 hrs	Point of failure
Event Strong Motion Records		D4	Tier 2	Tier 2	Outage time + 2.5 wks	Point of failure

14.14 Function 10: Post Processing – Data Exchange Between Networks – Amplitudes (Ground Motion Exchange)

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
PP Data Exchange -Amps		D1	Tier 3	Tier 3	48 hrs	Point of failure
PP Data Exchange -Amps		D2	Tier 2	Tier 2	48 hrs	Point of failure
PP Data Exchange -Amps		D3	Tier 2	Tier 2	Outage time + 24 hrs	Point of failure

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
PP Data Exchange -Amps		D4	Tier 2	Tier 2	Outage time + 2 wks	Point of failure

14.15 Function 11: Post Processing – Moment Tensor

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Post Proc – Moment Tensor		D1	Tier 3	Tier 3	20min	Point of failure
Post Proc – Moment Tensor		D2	Tier 3	Tier 3	20min	Point of failure
Post Proc – Moment Tensor		D3	Tier 2	Tier 1	0	Point of failure
Post Proc – Moment Tensor		D4	Tier 1	Tier 1	0	Point of failure

14.16 Function 12: Post Processing – Notification (PDL notification, ShakeMap alarm, internal notification)

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
RT/Post Proc – Notification		D1	Tier 3*	Tier 4	0	Point of failure†
RT/Post Proc – Notification		D2	Tier 2	Tier 2	24 hrs	Point of failure†
RT/Post Proc – Notification		D3	Tier 2	Tier 2	Outage time + 1 hr	Point of failure†
RT/Post Proc – Notification		D4	Tier 1	Tier 2	Outage time + 2 wks	Point of failure†

14.17 Function 13: Data Archival – Waveforms

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Data Archival – Waveforms		D1	Tier 3	Tier 3	Time of RT failover	Point of failure
Data Archival – Waveforms		D2	Tier 1/Tier 2	Tier 2	24 hrs	Point of failure

* Only for PDL notification, ShakeMap and internal alarms not at Tier 3

† For PDL

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Data Archival – Waveforms		D3	Tier 1/Tier 0	Tier 2	Outage time + 24 hrs	Point of failure*
Data Archival – Waveforms		D4	Tier 1	Tier 2	Outage time + 2 wks	Point of failure*

14.18 Function 14: Public Distribution – Waveforms

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Public distribution – Waveforms		D1	Tier 4	Tier 4	0	N/A
Public distribution – Waveforms		D2	Tier 1/Tier 2	Tier 2	24 hrs	N/A
Public distribution – Waveforms		D3	Tier 1/Tier 2	Tier 2	Outage time + 24 hrs	N/A
Public distribution – Waveforms		D4	Tier 1/Tier 2	Tier 2	Outage time + 2 wks	N/A

* Limited by wavepool/baler capacity

14.19 Function 15: Data Archival – Event Bulletin

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Data Archival – Event Bulletin		D1	Tier 3	Tier 3	Time of RT failover	Point of failure
Data Archival – Event Bulletin		D2	Tier 2	Tier 2	24 hrs	Point of failure
Data Archival – Event Bulletin		D3	Tier 2	Tier 2	Outage time + 24 hrs	Point of failure*
Data Archival – Event Bulletin		D4	Tier 2	Tier 2	Outage time + 2 wks	Point of failure*

14.20 Function 16: Public Distribution – Event Bulletin (includes STP, scedc.caltech.edu)

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Public distribution – Event Bulletin		D1	Tier 4	Tier 4	0	N/A

* Limited by wavepool/baler capacity

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Public distribution – Event Bulletin		D2	Tier 1/Tier 2	Tier 2	24 hrs	N/A
Public distribution – Event Bulletin		D3	Tier 1/Tier 2	Tier 2	Outage time + 24 hrs	N/A
Public distribution – Event Bulletin		D4	Tier 1/Tier 2	Tier 2	Outage time + 2 wks	N/A

14.21 Function 17: Data Archival – Station Metadata (SIS)

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Data Archival – Station Metadata		D1	Tier 2	Tier 2	48 hrs	Point of failure
Data Archival – Station Metadata		D2	Tier 2	Tier 2	1 wk	Point of failure
Data Archival – Station Metadata		D3	Tier 2	Tier 2	Outage time + 2 wks	Point of failure
Data Archival – Station Metadata		D4	Tier 0	Tier 2	Outage time + 2 wks	Point of failure

14.22 Function 18: Public Distribution – Station Metadata

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Public distribution – Station Metadata		D1	Tier 1/Tier 2	Tier 1/Tier 2	48 hrs	N/A
Public distribution – Station Metadata		D2	Tier 1/Tier 2	Tier 1/Tier 2	1 wk	N/A
Public distribution – Station Metadata		D3	Tier 1/Tier 2	Tier 1/Tier 2	2 wks	N/A
Public distribution – Station Metadata		D4	Tier 1/Tier 2	Tier 1/Tier 2	2 wks	N/A

14.23 Function 19: Public Distribution – Special Report (www.scsn.org)

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Required Hours of Operation:						
Public distribution – Special Report		D1	Tier 4	Tier 4	0 hrs	Point of failure
Public distribution – Special Report		D2	Tier 4	Tier 4	0 hrs	Point of failure

Functions	Criticality	Disruption Level	Current Recovery Tier	Required Recovery Tier	Recovery Time Objective	Recovery Point Objective
Public distribution – Special Report		D3	Tier 1/Tier 2	Tier 2	outage time + 24 hrs	Point of failure
Public distribution – Special Report		D4	Tier 1/Tier 2	Tier 2	outage time + 2 wks	Point of failure