NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Technical Rationale

New and Modified Terms, and Exemption Language Used in NERC Reliability Standards | Project 2016-02 Modification to CIP Standards

Proposed Modified Terms:

BES Cyber Asset (BCA)

A Cyber Asset or Virtual Cyber Asset, that if rendered unavailable, degraded, or misused would, within 15 minutes of its required operation, misoperation, or non-operation, adversely impact one or more Facilities, systems, or equipment, which, if destroyed, degraded, or otherwise rendered unavailable when needed, would affect the reliable operation of the Bulk Electric System. Redundancy of affected Facilities, systems, and equipment shall not be considered when determining adverse impact. Each BES Cyber Asset is included in one or more BES Cyber Systems.

Rationale

The BCA definition is changing to allow for BCA to be either Cyber Assets (hardware included) or Virtual Cyber Assets (VCA) (software only virtual machines without the underlying hardware). The definition of BCA excludes the underlying hardware for virtualized environments, now defined as Shared Cyber Infrastructure (SCI). The standards drafting team (SDT) recognizes that SCI indeed has the same impact as a virtual BCA and even more so if hosting numerous BCA, and those risks will be addressed in requirements specifically for the SCI. See the VCA and SCI definition below.

BES Cyber System (BCS)

One or more BES Cyber Assets logically grouped by a Responsible Entity to perform one or more reliability tasks for a functional entity, including Shared Cyber Infrastructure grouped, by the Responsible Entity, in the BES Cyber System it supports.

Rationale

The SDT is adding the option (known as the "all-in" scenario) for entities to group their SCI within a BCS it supports. See the CIP-002 Technical Rationale document for a description of the options for identifying SCI and reasons an entity may choose between the options. In addition, to shorten several applicability statements within the body of CIP standards, the SDT proposes that "BCS" be added as the defined acronym for "BES Cyber System" to the NERC glossary.

BES Cyber System Information (BCSI)

Information about the BES Cyber System or Shared Cyber Infrastructure that could be used to gain unauthorized access or pose a security threat to the BES Cyber System. BES Cyber System Information does not include individual pieces of information that by themselves do not pose a threat or could not be used to allow unauthorized access to BES Cyber Systems, such as, but not limited to, device names, individual IP addresses without context, ESP names, or policy statements. Examples of BES Cyber System Information may include, but are not limited to, security procedures or security information about BES Cyber Systems, Shared Cyber Infrastructure, Physical Access Control Systems, and Electronic Access Control or Monitoring

Systems that is not publicly available and could be used to allow unauthorized access or unauthorized distribution; collections of network addresses; and network topology of the BES Cyber System

Rationale

Conforming changes such that BCSI includes information about SCI.

CIP Senior Manager

A single senior management official with overall authority and responsibility for leading and managing implementation of and continuing adherence to the requirements within the NERC Critical Infrastructure Protection Standards.

Rationale

Remove explicit reference to the CIP standards as only "CIP-002 through CIP-011" as the body of CIP standards has grown beyond CIP-011. As an example, the CIP Senior Manager also has requirements within CIP-013.

Cyber Assets

Programmable electronic devices, including the hardware, software, and data in those devices; excluding Shared Cyber Infrastructure.

Rationale

Modified to explicitly exclude SCI from the definition of CA such that SCI and CA are two hardware 'forms' on which the other types of cyber systems reside. SCI is another form of 'programmable electronic devices' that do NOT include the software and data in the hardware devices. SCI is defined separately such that it can be the object of additional requirements based on its unique risks.

Cyber Security Incident

A malicious act or suspicious event that:

- For a high or medium impact BES Cyber System, compromises or attempts to compromise (1) an Electronic Security Perimeter, (2) a Physical Security Perimeter, (3) an Electronic Access Control or Monitoring System, or (4) Shared Cyber Infrastructure; or
- Disrupts or attempts to disrupt the operation of a BES Cyber System.

Rationale

Modified to add SCI to the scope of compromised or attempted compromise systems.

Electronic Access Control or Monitoring Systems (EACMS)

Cyber Assets, Virtual Cyber Assets, or Shared Cyber Infrastructure that perform electronic access control or electronic access monitoring of the Electronic Security Perimeter(s) or BES Cyber Systems or Shared Cyber Infrastructure. This includes Intermediate Systems and SCI grouped, by the Responsible Entity, in the EACMS it supports.

Rationale

Modified to add VCA and SCI as two other forms that an EACMS can take and add SCI as an object of the access control or monitoring. EACMS also includes the SCI grouped by the Responsible Entity with a virtualized EACMS it supports.

Electronic Access Point (EAP)

A policy enforcement point, or a Cyber Asset interface that allows routable communication to and from the BES Cyber System within an ESP.

Rationale

As network security moves deeper into the infrastructure, its no longer necessary to prescribe that network security be performed on a 'Cyber Asset interface on an ESP'; at one point on a network edge. Zero Trust, for example, highly distributes the network security model and is not perimeter-based. With the added flexibility in CIP-005 to adopt these models in addition to the traditional ESP model, the term EAP is being modified to allow for policy enforcement points and no longer prescribes an architecture.

External Routable Connectivity (ERC)

The ability to communicate to a CIP System using a bi-directional routable protocol from outside the asset containing the CIP System.

Rationale

The ERC definition is undergoing a clarification from an ability to "access" to an ability to "communicate" so it is a more connectivity-based term and distinguished from user access-based terms such as IRA. The ERC term is used throughout the CIP Standards within the Applicable Systems column as a scoping mechanism based on the inherent risk associated with external routable connectivity as well as to limit the scope of requirements that would require ERC to function. The SDT is maintaining this use of ERC, but also clarifying the relationship between ERC and IRA in that a non-routable, serial only CIP System may have ERC and have IRA through the ERC through a subsequent IP/serial conversion (see changes to IRA definition). The definition was also modified to use the newly proposed 'CIP System' glossary term as shorthand for the various types of Cyber Systems that are in CIP scope. The intent is a CIP System within a BES asset has ERC if it is reachable by a bi-directional routable protocol from outside of the asset containing it. Cyber Assets on an isolated, standalone routable protocol network within a BES asset that cannot be reached from outside the asset (e.g., a PLC, HMI, and switch network as a standalone system with no firewall or router connections to any other network) would not have ERC.

ERC is no longer based on 'external' being defined in terms of the ESP as ESPs are changing in light of Zero Trust models. Zero Trust will shrink ESP's over time to the smallest, most granular object possible including a single device or possibly to process or resource level on a device. In this model, many dynamic, short-lived session level 'perimeters' may exist. In these implementations as the ESP shrinks, if ERC continues to be based on ESP then the 'external' in ERC begins to lose meaning, thus the move away from ESP for the determination of what is external. Therefore, the SDT is modifying the object of the "outside of " statement to be external to the asset containing the CIP System being accessed, because

that ts the logical object where both the risk elevates, and the connectivity capability must exist so that the ERC definition can fulfill both of the current scoping goals in place within the CIP Standards.

Electronic Security Perimeter (ESP)
A set of configurations or policies enforced by an EACMS that controls communications to or from any part of a BES Cyber System. These configurations or policies group CIP Systems of the same impact rating and their associated PCAs.

Rationale
The traditional network-edge Electronic Security Perimeter remains a valid network security model, however it is no longer the only prescribed model as CIP-005 allows other access control models that are not based on network perimeters such as Zero Trust architectures. The proposed ESP definition is more objective-oriented and is no longer network-location centric as security models such as Zero Trust move away from implicit trust within network perimeters and using network location as a primary factor in access control decisions. In these models, the perimeter shrinks to increasingly more granular levels, potentially down to a process or resource level on a BCS and nothing on the network is trusted for unrestricted communications. The proposed definition allows for an ESP to be (a) static point(s) on a network boundary such as a traditional FW that is enforcing access policies or configurations (e.g., FW rulesets), (b) many dynamic, short-lived, session-level 'perimeters' established at time of access that are network independent (e.g., users to resources, for example), or (c) hybrid implementations combining elements of both.

Interactive Remote Access (IRA)
User-initiated real-time access by a person from outside of the Responsible Entity's Electronic Security Perimeters (ESP) using a routable protocol:

- to a Cyber System within an ESP;
- through a Cyber Asset or Virtual Cyber Asset that is converting communications from a routable protocol to a non-routable protocol to a Cyber System not within an Electronic Security Perimeter;
- To Management Interfaces of a Shared Cyber Infrastructure; or
- To Management Interfaces of an Electronic Access Control or Monitoring Systems that enforces an ESP.

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Rationale
The proposed IRA definition changes in two fundamental ways: (1) to incorporate as IRA situations where a BCS has ERC and through it users outside of any of the Responsible Entity's ESPs have access to non-routable (serial) CIP Systems within the asset through a subsequent IP/serial conversion, and (b) to include the Management Interfaces of SCI or EACMS that enforce an ESP as targets of IRA, such that IRA includes not only objects within an ESP, but the objects that enforce the ESP as well. The references to ownership of the remote client have been removed.

Intermediate Systems
One or more Electronic Access Control or Monitoring Systems that are used to restrict Interactive Remote Access to only authorized users .

Rationale

The IS definition is changing to remove requirement language (i.e., where an Intermediate System must reside) embedded within the definition. Such language has been moved to CIP-005 R2 within a mandatory requirement. The definition was also updated from a Cyber Asset focus to an EACMS focus to include more forms (i.e., VCA) the Intermediate System can take.

Physical Access Control Systems (PACS)

Cyber Assets, Virtual Cyber Assets, or Shared Cyber Infrastructure (SCI) (including SCI grouped, by the Responsible Entity, in the Physical Access Control Systems it supports) that control, alert, or log access to the Physical Security Perimeter(s), exclusive of locally mounted hardware or devices at the Physical Security Perimeter such as motion sensors, electronic lock control mechanisms, and badge readers.

Rationale

Modified to add VCA and SCI as two other forms that a PACS can take. PACS also include the SCI grouped by the Responsible Entity with a virtualized PACS it supports.

Physical Security Perimeter (PSP)

The physical border surrounding locations in which BES Cyber Assets, BES Cyber Systems, Shared Cyber Infrastructure, or Electronic Access Control or Monitoring Systems reside, and for which access is controlled.

Rationale

The PSP definition is changing to add SCI as type of device which must be within a PSP.

Protected Cyber Asset (PCA)

One or more Cyber Assets or Virtual Cyber Assets that:

- Is within an Electronic Security Perimeter, but is not part of the highest impact BES Cyber System within the same Electronic Security Perimeter; or
- Share CPU or memory with any part of a BES Cyber System, excluding Virtual Cyber Assets that are being actively remediated prior to introduction to the ESP.

Rationale

The PCA definition is being updated to include “share CPU or memory with any part of a BES Cyber System” to mitigate the risks of hardware-based vulnerabilities (Spectre, Meltdown, Rowhammer, etc.) on Shared Cyber Infrastructure for any virtual machines allowed to run on the same hardware as BES Cyber Systems. Since virtualization can allow systems of differing trust levels to simultaneously execute on the same hypervisor servers in the hardware underlay and thus share the same CPU and memory, this addition to the PCA definition requires that those VCAs that do share CPU and memory with a BCS become associated PCA’s of the BCS. This provides the high water marking of VCAs sharing a single hypervisor’s CPU or memory. Affinity rules can be used within the virtualization configuration to prevent this situation and keep other VCAs from becoming associated PCAs. Finally, the definition is being modified to account for “remediation VLAN” automation of security controls where a VCA may instantiate in a logical network reserved for vulnerability assessment and updates (OS patches, AV updates, etc.).

The intent is the VCA does not become a PCA while temporarily in this state as its being updated prior to being connected to its production network.

Removable Media
Storage media that (i) are not Cyber Assets or Shared Cyber Infrastructure, (ii) are capable of transferring executable code, (iii) can be used to store, copy, move, or access data, and (iv) are directly connected for 30 consecutive calendar days or less to a BES Cyber Asset, Shared Cyber Infrastructure, a network within an ESP, or a Protected Cyber Asset.

Rationale
The Removable Media definition is being updated to add SCI as a target of the Removable Media connection.

Reportable Cyber Security Incident
A Cyber Security Incident that compromised or disrupted:
- A BES Cyber System that performs one or more reliability tasks of a functional entity;
- An Electronic Security Perimeter of a high or medium impact BES Cyber System;
- An Electronic Access Control or Monitoring System of a high or medium impact BES Cyber System; or
- Shared Cyber Infrastructure supporting a BES Cyber System.

Rationale
This definition is being modified to add compromised or disrupted SCI supporting a BCS as a target.

Transient Cyber Asset (TCA)
A Cyber Asset or Virtual Cyber Asset that is:

1. capable of transmitting or transferring executable code,
2. not included in a BES Cyber System,
3. not a Protected Cyber Asset (PCA) associated with high or medium impact BES Cyber Systems, and
4. connected for 30 consecutive calendar days or less:
    - to a network within an Electronic Security Perimeter containing high or medium impact BES Cyber Systems, or
    - directly (e.g., using Ethernet, serial, Universal Serial Bus, or wireless including near field or Bluetooth communication) to a:
        - BES Cyber Asset,
        - Shared Cyber Infrastructure, or
        - Protected Cyber Asset associated with high or medium impact BES Cyber Systems.

Virtual machines hosted on a physical TCA can be treated as software on that physical TCA.
Examples of Transient Cyber Assets include, but are not limited to, Cyber Assets or Virtual Cyber Assets used for data transfer, vulnerability assessment, maintenance, or troubleshooting purposes.

Rationale

The TCA definition is being updated to add VCA as a form a TCA can take. The intent is to handle VCAs that are created for typical TCA uses but are normally dormant (e.g. a VCA with Wireshark for troubleshooting network issues within a virtualized infrastructure). Additionally, SCI was added as a target to which TCA's can be directly connected. The statement "Virtual machines hosted on a physical TCA can be treated as software on that physical TCA" is to clarify that on a physical TCA (laptop) with hypervisor software and one or more VCA images, the hypervisor and VCAs are treated as software on the one physical TCA. This is to clarify that the one physical TCA does not have to be tracked simultaneously as multiple distinct virtual TCAs. Corresponding clarifications have been made to the methods in CIP-003 and CIP-010 used to mitigate the risks of TCA software.

Proposed New Terms:

CIP System

A Cyber System identified by the Responsible Entity as a BES Cyber System, Electronic Access Control or Monitoring System, Physical Access Control System, Shared Cyber Infrastructure, Protected Cyber Asset, or Transient Cyber Asset.

Rationale

This term was created to simplify applicability when referring in the standards or other definitions to objects in scope of the NERC CIP standards in any form they may take (CA, VCA, SCI). It also simplifies applicability when a referral to a "non-CIP System" is needed. If other object types are needed in the future, their addition to this one definition can reduce needed edits throughout the standards.

Cyber System

A group of one or more Cyber Assets, Virtual Cyber Assets, or Shared Cyber Infrastructure.

Rationale

This proposed new term is used to simplify applicability when referring in the standards or other definitions to all the forms an object may take (CA, VCA, or SCI). If other forms are needed in the future, their addition to this one definition can reduce needed edits throughout the standards.

Management Interface

A user interface, logical interface, or dedicated physical port that is used to:

- Control the processes of initializing, deploying, and configuring SCI; or
- Provide lights-out management capabilities; or
- Configure an ESP;

excluding physical user interfaces (e.g., power switch, touch panel, etc)..

Rationale

This term is being defined so that requirements can be addressed to SCI and EACMS Management Interfaces to target the unique risks for virtualized environments presented by the management

'consoles' for such environments. With 'infrastructure as a service' (IaaS) environments, the management consoles can not only be used to create, but also to destroy or reconfigure virtual servers, networks, switches, firewalls, etc. The term also includes interfaces commonly known as ILO (Integrated Lights Out), that can be used to remotely manage hardware (usually including power on/off, access to the physical console, etc.). It also includes interfaces used to configure an ESP (such as on firewalls or a network switch that is enforcing an ESP between different logical networks (e.g., VLANs).

Shared Cyber Infrastructure (SCI)

One or more programmable electronic devices, including the software and Management Interfaces, that share:

- CPU and memory resources with one or more Virtual Cyber Assets identified as a BCA, EACMS, or PACS; or
- storage resources with any part of a BES Cyber System or their associated EACMS or PACS

Each SCI is either:

- included in one or more BES Cyber Systems, EACMS, or PACS; or
- identified independently.

SCI does not include the supported VCA or CA with which it shares its resources. .

Rationale

The SCI definition is being created to separate the underlying hardware from the VCAs that it hosts. This allows security requirements to be targeted to SCI to address the unique risks of virtualization and shared hardware. There are many requirements that now include the newly defined term SCI in the "Applicable Systems" column to maintain security level parity with traditional Cyber Assets.

Beyond security level parity with protecting a typical hardware based Cyber Asset, the SCI can have a more significant impact in a virtualized environment since it can host, and therefore impact, multiple virtualized systems. Because of this capability, some additional controls only apply to SCI, such as the management plane isolation required by the proposed CIP-005. Addressing these unique risks requires separation of the hardware underlay into a separate definition.

The second set of bullets in the definition outlines two options for identifying SCI. Please see the CIP-002-7 Technical Rationale document for a discussion of these options.

The phrase "SCI does not include the supported VCA or CA with which it shares its resources" is included to clarify that, for example, electronic access to a hosted VCA by a user is not electronic access to the SCI on which it executes.

Of note is that shared network devices are not in the scope of this definition. Since network switches and firewalls share their resources by nature, this exclusion avoids pulling all network hardware into scope as SCI. However, network switches and other hardware that does enforce an ESP (such as a network switch configured to logical isolate different VLANs) comes into scope as an EACMS.

Virtual Cyber Asset (VCA)
A logical instance of an operating system or firmware hosted on Shared Cyber Infrastructure or a Cyber Asset.

Rationale
The NERC Glossary definition of Cyber Asset has a direct tie to the hardware on which it relied. This affected the definitions of the "Applicable Systems" terms such as BES Cyber Systems (BCS), EACMS, PACS, and Protected Cyber Assets (PCAs). Because the Reliability Standard is applicable to the aforementioned systems, the control for the Cyber Assets also applies to the hardware. This one-to-one relationship between a Cyber Asset and its underlying hardware is what virtualization intentionally breaks to increase reliability and resiliency by allowing Virtual Cyber Assets to be abstracted from the hardware and therefore able move to any available hardware out of a pool of resources.

The proposed NERC Glossary definition of Virtual Cyber Asset (VCA) allows the tie between a specific piece of hardware and the related applicable systems to no longer be singularly defined. The definition of VCA is not inclusive of hardware, and other related definitions (EACMS, PACS, PCA, TCA, etc.) have been updated to allow for VCA versions. With the addition of SCI and revisions to the "Applicable Systems", there can be one or more virtualized instances (each a VCA) of a BCA, EACMS, PACS or PCA that reside on SCI.
Examples of Virtual Cyber Assets may include, but are not limited to, logical instances of the following:

- Operating Systems (Virtual Machines (VM));
- Networking devices such as switches, routers, and load balancers;
- Security appliances such as firewalls and VPN concentrators; and
- Helper appliances with logical connectivity (such as malware detection, plugins, etc.).

Proposed Retired Terms:

None

Technical Rationale for Exemptions Section:

Rationale for Exemption 4.2.3.1

The term 'Cyber Assets' was changed to 'Cyber systems'. Rather than changing this language to a list of all possible forms (Cyber Assets, Virtual Cyber Assets, or Shared Cyber Infrastructure) as the object of the exemption, the SDT chose to instead use the existing language in the 4.2.3.4 and 4.2.3.5 exemptions such that all five exemptions use 'systems' as their object.

Rationale for Exemption 4.2.3.2 and 4.2.3.3

In 4.2.3.2, the term 'Cyber Assets' was changed to 'Cyber Systems' which is a new proposed glossary addition. Rather than changing these two exemptions to list all possible forms (Cyber Assets, Virtual Cyber Assets, or Shared Cyber Infrastructure), the SDT chose to define a new term that incorporates all forms and use it within the multiple exemptions and at other points within the standards.

For 4.2.3.3, the ability to move workloads or VM's seamlessly across different sites for increased resiliency can require different sites to be connected as a flat network without layer 3 ESP's at each discrete site (e.g., a layer 2 adjacency across the sites). A "Super ESP" as its been historically known is created across the sites and thus an exemption based on having a discrete layer 3 ESP at each site no longer works to exclude, for example, the network transport equipment belonging to carriers. The SDT is including the 4.2.3.3 exemption to further clarify this scenario. Responsible Entities should notice the exemption uses the word "between" – when extending an ESP between geographic locations, CIP-005 requires the confidentiality and integrity protection of the data (typically through encryption) between the relevant PSPs. This exemption then covers the related Cyber Systems "between" those encryption points but does not exclude the endpoints performing the encryption.