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## Machine Protection Glossary

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	Name	Role/Title
<b>Owner</b>	Szandra Kövecses	Lead Integrator, ICS/Machine Protection
<b>Reviewer</b>	Annika Nordt	Group Leader, ICS/Protection Systems
	Enric Bargalló	Lead Analyst, ICS/Machine Protection
	Riccard Andersson	Technical Project Coordinator, ICS/Protection Systems
	Manuel Zaera-Sanz	PLC Engineer, ICS/Machine Protection
	Christian Hilbes	In-kind partner, ICS/Zurich University of Applied Sciences (Zhaw)
	Martin Rejzek	In-kind partner, ICS/Zurich University of Applied Sciences (Zhaw)

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## 1. SCOPE

This document contains the definitions and explanations of terms that are used in the context of Machine Protection at ESS.

## 2. PURPOSE

The purpose of this document is to create a glossary that provides a clear definition of terms and concepts to simplify communication when discussing Machine Protection at ESS.

## 3. DEFINITIONS

Term	Definitions
<b>Machine</b>	In the context of ESS Machine Protection, the term “ <b>Machine</b> ” encompasses all elements in the Accelerator, Target Station and Neutron Science system segments; all elements necessary for neutron beam production and its further use by the neutron science experiments.
<b>Failure</b>	The <b>Machine</b> , a device or data being affected by internal factors in such a way that it (partly or entirely) cannot perform its intended task.
<b>Hazard</b>	Potential source of <b>Damage</b> or <b>Activation</b> .
<b>Damage</b>	The <b>Machine</b> or data being affected by external factors in such a way that it (partly or entirely) cannot perform its intended task.
<b>Activation</b>	Induced radioactivity in previously stable material through exposure to radiation.
<b>Damage Event</b>	Event in which a <b>Hazard</b> results in <b>Damage</b> .
<b>Activation Event</b>	Event in which a <b>Hazard</b> results in <b>Activation</b> .
<b>Damage Risk</b>	Combination of the frequency of occurrence of <b>Damage</b> and the severity of that <b>Damage</b> .
<b>Activation Risk</b>	Combination of the frequency of occurrence of <b>Activation</b> and the severity of that <b>Activation</b> .
<b>Hazardous State</b>	State that might lead to unacceptable <b>Damage Risks</b> or <b>Activation Risks</b> for the <b>Machine</b> .

<b>Protected State</b>	State in which the <b>Machine</b> is free from unacceptable <b>Damage</b> and <b>Activation Risks</b> .
<b>Off-nominal state</b>	A state of the equipment or the controlled process that might result in a <b>Hazard</b> .
<b>Overall Protection Function</b>	Means of achieving or maintaining a <b>Protected State</b> for the <b>Machine</b> , in respect to one specific <b>Hazard</b> . The <b>Overall Protection Function</b> does not specify the technology to be used to achieve the means.
<b>Protection Function</b>	<p>Function implemented by one or several <b>MP-related Systems</b>, which is intended to achieve and maintain the <b>Protected State</b> of the <b>Machine</b> in respect to one specific <b>Hazard</b>.</p> <p>A <b>Protection Function</b> is defined by:</p> <ul style="list-style-type: none"> <li>• Sensor</li> <li>• Logic</li> <li>• Actuator</li> <li>• <b>Protection Integrity Level</b></li> </ul> <p>And for some functions:</p> <ul style="list-style-type: none"> <li>• Time requirement, for the completion of the <b>Protection Function</b>, from detection to actuation.</li> </ul> <p>See <b>MP-related Sensor Systems</b>, <b>MP-related Logic Systems</b> and <b>MP-related Actuation Systems</b></p>
<b>Protection Integrity Level (PIL)</b>	Discrete level (from zero to four) specifying the random hardware <b>Failure</b> and systematic <b>Failure</b> requirements related to dangerous modes or <b>Failures</b> of a <b>Protection Function</b> . <b>Protection Integrity Level 0</b> has the lowest and <b>Protection Integrity Level 4</b> has the highest requirements related to <b>Protection Function Failures</b> . The <b>Protection Integrity Level</b> requirements relate to the entire <b>Protection Function</b> and is allocated to all of its constituent systems.
<b>Local Protection Function</b>	A <b>Local Protection Function</b> is a <b>Protection Function</b> where the sensor, logic and actuator chain is contained within the same system. <b>Local Protection Functions</b> are often related to the operation and control of the device or equipment.
<b>Local Protection System (LPS)</b>	A single or a set of systems that implement <b>Local Protection Functions</b> . A <b>Local Protection System</b> can simultaneously implement part of a <b>Global Protection Function</b> , which means it can also act as an <b>MP-related Sensor System</b> .

<b>Global Protection Function</b>	A <b>Global Protection Function</b> is a <b>Protection Function</b> where the sensor, logic and actuator chain is range over multiple systems. <b>Global Protection Functions</b> are often related to Beam Induced <b>Damage</b> and Beam Loss.
<b>Machine Protection System of Systems (MP-SoS)</b>	The set of all <b>MP-related Systems</b> .
<b>Machine Protection-related System (MP-related System)</b>	Systems that implement part of or complete <b>Protection Functions</b> and Systems that are intended to achieve the necessary <b>Protection Integrity Level</b> of the required <b>Protection Functions</b> .
<b>MP-related Sensor System</b>	<b>MP-related Sensor Systems</b> implement the sensor part of a <b>Global Protection Function</b> . They measure parameters necessary to detect the presence of a <b>Hazard</b> . Processing of those physical properties and detection of the presence of a <b>Hazard</b> can be part of an <b>MP-related Sensor System</b> .
<b>MP-related Beam Monitoring System</b>	<b>MP-related Sensor Systems</b> which measures beam parameters or its losses.
<b>MP-related Logic System</b>	<b>MP-related Logic Systems</b> implement the logic part of a <b>Global Protection Function</b> . <b>MP-related Logic Systems</b> evaluate information collected from <b>MP-related Sensor Systems</b> . Based on the current operational context of the <b>Machine</b> , they control the MP-related Actuation Systems to achieve and maintain a <b>Protected State</b> .
<b>MP-related Actuator System</b>	<b>MP-related Actuator Systems</b> implement the actuator part of a <b>Global Protection Function</b> . Systems that are capable of stopping proton beam operation and preventing proton beam generation.
<b>Higher-Level Operation Critical Systems</b>	<b>Higher-Level Operation Critical Systems</b> are those systems that are essential for operation and that need to work properly before allowing for beam production. Higher-level systems include basic process control systems but also for example the Target Safety Systems and Personnel Safety Systems.
<b>Beam Interlock System (BIS)</b>	The set of <b>MP-related Logic Systems</b> . The <b>Beam Interlock System</b> evaluates all <b>Beam-Permit</b> signals and controls the MP-related Actuation Systems.

<b>Fast Beam Interlock System (FBIS)</b>	The FBIS is part of the Machine Protection System-of-Systems. In essence the FBIS is the final link between the MP-related Actuation Systems and other MP-related systems for MP-related purposes.
<b>Beam-Permit</b>	A binary signal generated by <b>MP-related Systems</b> , a <b>Beam-Permit</b> signal can have the value OK or NOK (Not OK).  An <b>MP-related System</b> sets a <b>Beam-Permit</b> output to the value OK if it does not see any reason to prevent beam (it is healthy and ready for beam production). Otherwise, it sets the <b>Beam-Permit</b> output to the value NOK (Not OK).
<b>Functional Readiness</b>	The property of a system to be ready for performing its intended function upon demand.
<b>System Health</b>	Condition of a system indicating whether the system performs within its specifications.
<b>Interceptive Device</b>	Device that can be move into and extracted from the beam-pipe.
<b>Proton Beam Destination</b>	The proton beam can be sent to different destinations: Faraday Cups, Beam Stops, as well as the Tuning Dump and the Target.
<b>Requested Proton Beam Destination</b>	The <b>Proton Beam Destination</b> that the operator requests. The Timing System is broadcasting the <b>Requested Proton Beam Destination</b> and <b>Requested Proton Beam Mode</b> to all relevant systems.
<b>Configured Proton Beam Destination</b>	The <b>Proton Beam Destination</b> the system is configured for.
<b>Detected Proton Beam Destination</b>	The <b>Proton Beam Destination</b> that is detected (by sensors).
<b>Proton Beam Mode</b>	Information specifying limits for physical beam properties, including beam current, beam pulse length, and pulse repetition rate.
<b>Requested Proton Beam Mode</b>	The Beam <b>Proton Beam Mode</b> that the operator requests. The Timing System is broadcasting the <b>Requested Proton Beam Destination</b> and <b>Requested Proton Beam Mode</b> to all relevant systems.
<b>Configured Proton Beam Mode</b>	The <b>Proton Beam Mode</b> the system is configured for.

<b>Detected Proton Beam Mode</b>	The <b>Proton Beam Mode</b> that is detected (by sensors).
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#### 4. REFERENCES

[1]      <<Sample reference to CHESS document: ESS Document (ESS-00XXXXX)>>

#### DOCUMENT REVISION HISTORY

<b>Revision</b>	<b>Reason for and description of change</b>	<b>Author</b>	<b>Date</b>
1	First issue	Christian Hilbes	2017-03-31
2	Updated and adjusted to ESS template	Szandra Kövecses	2017-08-08