DSNA policy on software aspects

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Ministère de l'Écologie, du Développement durable, des Transports et du Logement

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DSNA

Presentation outlines

DSNA compliance with software regulation

DSNA SSAS

- Scope of application
- Software confidence level definition (SWAL, Current, Upgraded) and allocation process
- Software confidence level satisfaction process
- SSAS monitoring process

DSNA Hot spots

- COTS,
- How to justify that software functions do not adversely affect safety?
- Legacy software
- Current flawed architectures (ARTAS…)
- forthcoming network with routeurs)…

DSNA compliance with CE n°482/2008 SSAS methodology (May 2009)

Transposition of CE n°482 into an internal methodology → MET006, applicable from May 2009.

SSAS definition so as to provide assurances regarding :

- Validity of software requirements (all of them)
- Verification of software requirements
- Traceability,
- Software configuration management
- No adverse safety effect from a software functionality

Difficulty : No AMC available, nor envisioned for this regulation.

At that time, no ED153, nor CS SWAL published.

DSNA choice : to rely on ED109 and current practices in addition to complementary assurances to address maintenance, installation, and operation phases.

However confidence levels for legacy software not defined !

Significant pressure from the NSA on software aspects.

DSNA compliance with CE n°482/2008 Guidance for the SW methodology (August 2011)

August 2011 : release of a guidance to improve the SSAS application. Dedicated to project/safety practitionners with key enablers :

- to which type of software the software regulation applies
- leaflet to address the : organisation of the activities/evidences for the required assurances (who, what and how)
- COTS treatment policy,
- legacy software confidence level definition
- translation of ED109 into French to avoid English misunderstanding and jump into ED12B.

DSNA SSAS : generalities

Scope of application

Software confidence level allocation process

new software

legacy software

Software confidence level satisfaction process

- Validity of software requirements (all of them)
- Verification of software requirements
- Traceability,
- Software configuration management
- No adverse software safety effect

SSAS Monitoring (in progress)

- ensure that the confidence level is appropriately allocated
- ensure the satisfaction of the condifence level is adequate
- modify the SSAS accordingly (new measures, corrective actions to avoid deficincies in applying the directives).

DSNA SSAS : scope of application

- SSAS applies to any sofware creation/modification as part of the ATM/CNS system
  - Software definition (EC482) = sw version + config data
  - corrective maintenance bug fixing,
  - software new functionalities,
  - local development (e.g intrusive or passive supervision),
  - configuration data modification,
  - Command script in Unix to launch equipment, reload, reset
  - etc…
- but limited to software that are safety-related.
  - No bureautics software involved…

SSAS applies not necessarily in the frame of CE n°2096 change.

DSNA SSAS : scope of application

DSNA Strategy : to avoid triggering a safety process that could result with no software assurance required : so a change impact analysis is performed.

Criterion to seek safety-related software : 2 rules (not mutually exclusive) have been defined

- Rule 1:

  Any software connected to the operational network. Yet, when a change impact analysis shows that any failure mode of the software under study has no safety impact, no software assurance is required for the software (e.g: non-intrusive spying or data extracting software for the purpise of statistics)

- Rule 2:

  Any software off operational network whose output are consumed by the ATM/CNS system (Human, Equipment, Procedure). However, if a change impact analysis shows that software outputs are valid and verified before operational consumption, therefore no software assurance is required. (e.g: adaptation data configurator whose output are verified before equipment usage, planning resources software whose outuput are humanly verified before distribution, EFB-like software for maintenance staff).

Of course, where software modification is part of the ATM/CNS system functional envelope, no additional assurance is required. E.g Instanciation of adaptation data already covered by a safety study will be accomplished by ensuring adherence to this latter.

Software Confidence level Determination

2 methods for the SWAL

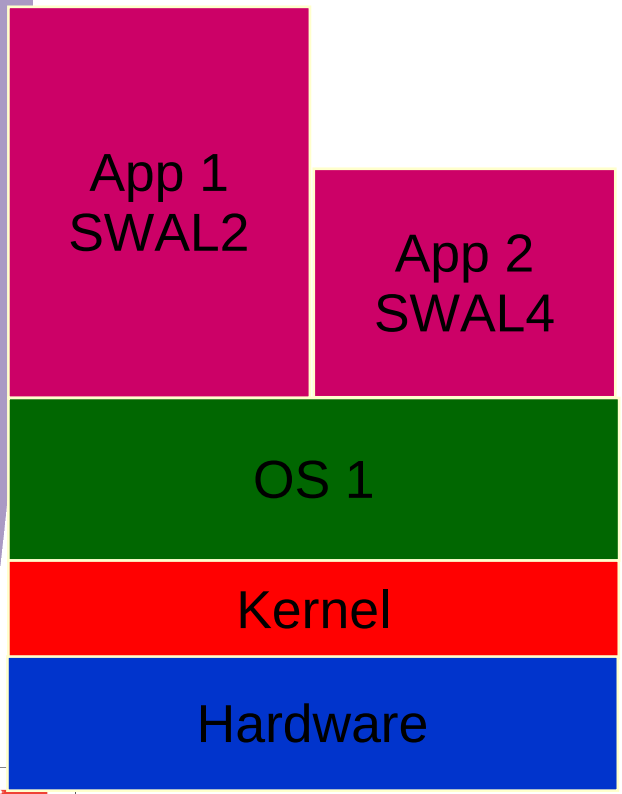
1 method for legacy software

Paramount question:
on which part of the software is the allocation performed?

- On the overall software (drivers, middleware, applicative, …) that runs on a hardware platform (microprocessor).

- On the software component level for those components running on a microcontroler, where isolation can be substantiated between them (e.g by the use of partitioning techniques to ensure spatial and temporal segregation

Why isolation is nedded to allocate at component level ?

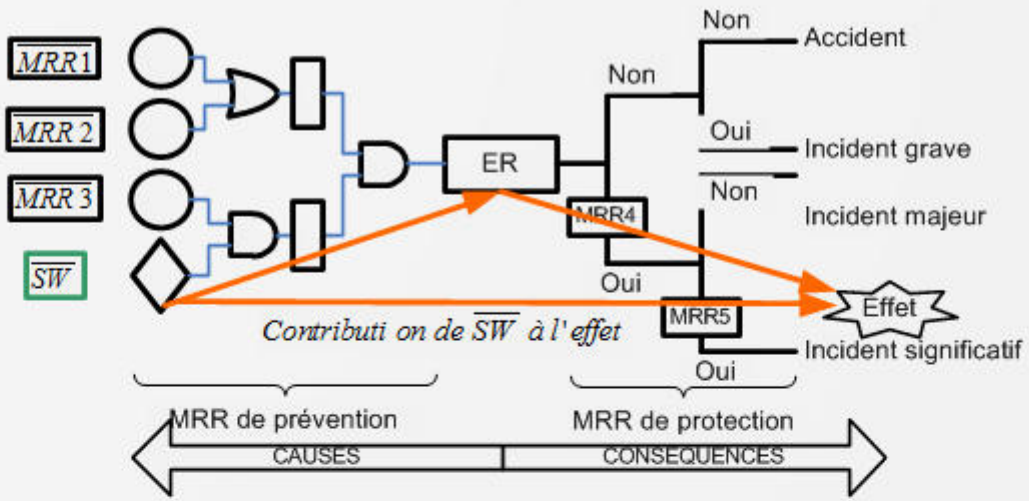


Quid when App2 exceeds its time frame or spatial allocation quantum; can App1 execute correctly ?
Isolation techniques are therefore required to allocate different SWAL.

SWAL determination : general method (ED153)

« Détermination du SWAL (méthode générale) »

General Principle:
For all HAZ in which the SW is involved, apply step 1 to 3 here-after. The final SWAL is the most stringent one.



1) Contribution identification :
In the WCC, assess the distance from the SW failure to the effect. 4 choices : Very Possible, Possible, Improbable and Extremely Improbable.

2) Contribution justification :
Very Possible : when no efficient & independent MM (external to the SW failure) exists.
Possible : when exists a set of MM (external to the SW failure) that is efficient and independent.
Improbable : when exists a set of MM (external to the SW failure) that is very efficient and independent.
Extremely Improbable : when exists a set of MM (external to the SW failure) that is extremely efficient and independent.

3) SWAL allocation :
Determination based on the combination effect severity class and SW failure contribution to the effect, as shown in the here-below matrix :

Degré de gravité de l'effet / Contribution à l'effet	1	2	3	4
Très Possible	SWAL 1	SWAL 2	SWAL 3	SWAL 4
Possible	SWAL 2	SWAL 3	**SWAL 3**	SWAL 4
Improbable	SWAL 3	**SWAL 3**	SWAL 4	SWAL 4
Extrêmement Improbable	SWAL 4	SWAL 4	SWAL 4	SWAL 4

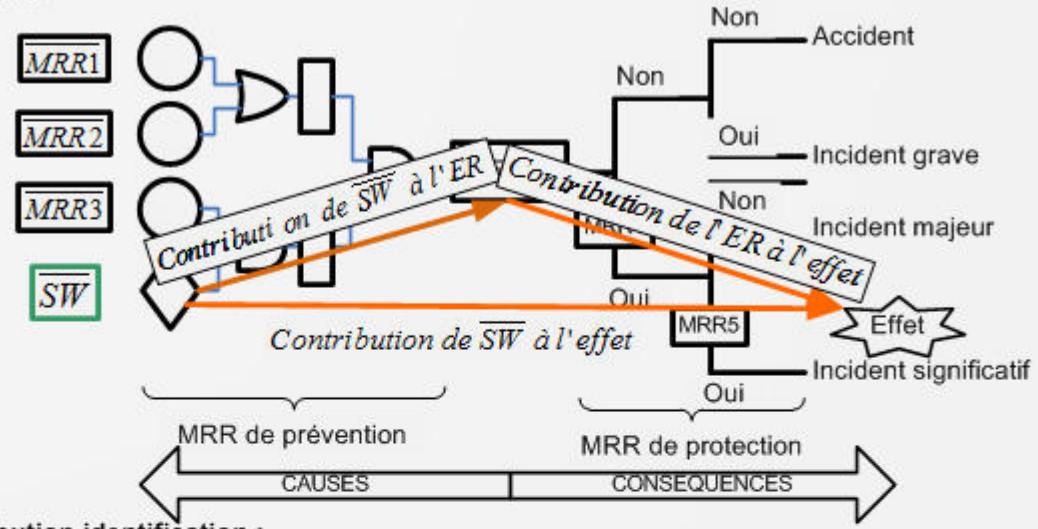
SWAL determination : DSNA alternate method

« Détermination du SWAL (méthode alternative) »

General principle :

Valid method in case no common modes exist between preventive and protective MM; otherwise, general method applies.

For all HAZ in which the SW is involved, apply step 1 to 3 here-after. The final SWAL is the most stringent one.



1) Contribution identification :

In the WCC, assess the distance from the SW failure to the HAZ by exploiring the fault trees. 3 choices : Direct, Simple Combination, Multiple Combination.

2) Contribution justification :

Direct : when no efficient & independent MM (external to the SW failure) exists.

Simple Combination : when exists a MM (external to the SW failure) that is efficient and independent.

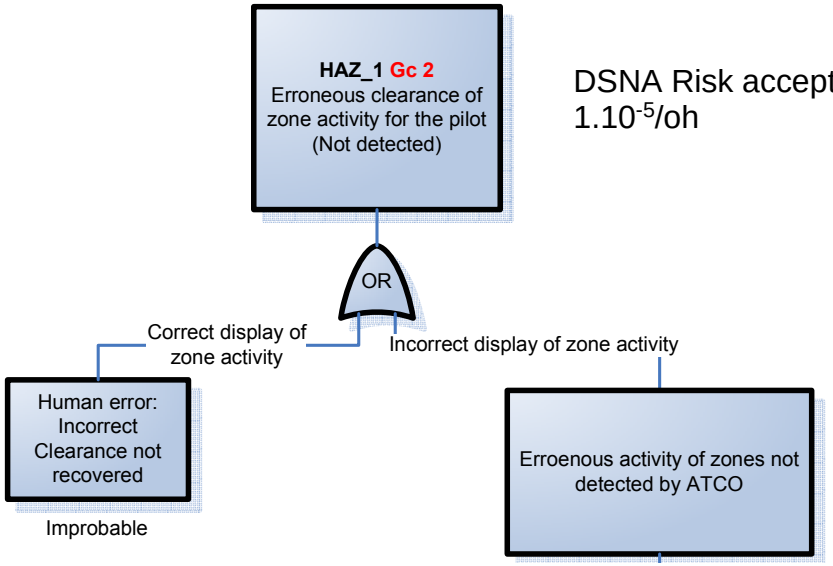
Multiple Combination : when exists a set of MM (external to the SW failure) that is very efficient and independent.

3) SWAL allocation :

Determination based on the severity level of the HAZ and SW failure contribution to the HAZ, as shown in the here-below matrix

Niveau de gravité corrigé de l'ER Contribution à l'ER	1	2	3	4	5
Directe	SWAL1	SWAL2	SWAL3	SWAL4	SWAL4
Combinaison simple	SWAL2	SWAL3	**SWAL3**	SWAL4	SWAL4
Combinaison multiple	SWAL3	**SWAL3**	SWAL4	SWAL4	SWAL4

Example of SWAL allocation



DSNA Risk acceptability matrix
1.10^{-5}/oh

1.10^{-6}/oh 10-90% distribution
Severity 2

1.10^{-5}/oh
(DSNA choice to have 2 equipment)
Severity 3

1.10^{-5}/oh
SWAL3

Confidence level determination : legacy software

« Détermination du niveau de confiance Actuel, Renforcé »

Confidence level Determination : either Current or Upgraded

The confidence level determination is obtained by considering:

1) the software criticality

2) the nature of the software modification

Nature of SW Modification / Criticality	Minor	Major
Low	Current	Current
High	Current	Upgraded
From low to high	Upgraded	Upgraded

1) Software Criticality

The criticality is estimated after the SW change.

The criticality is **LOW** when a SW failure :
- causes or contributes to a HAZ whose severity level is 4 or 5,
- contributes indirectly to a HAZ whose severity is 3 as it exists a set of MM external to the SW failure that is efficient and independent.
- contribute indirectly to a HAZ whose severity is 2 as it exists a set of MM external to the SW failure that is very efficient and independent.
- contribute indirectly to a HAZ whose severity is 1 as it exists a set of MM external to the SW failure that is extremely efficient and independent.

Oterhwise, the criticality is **HIGH**.

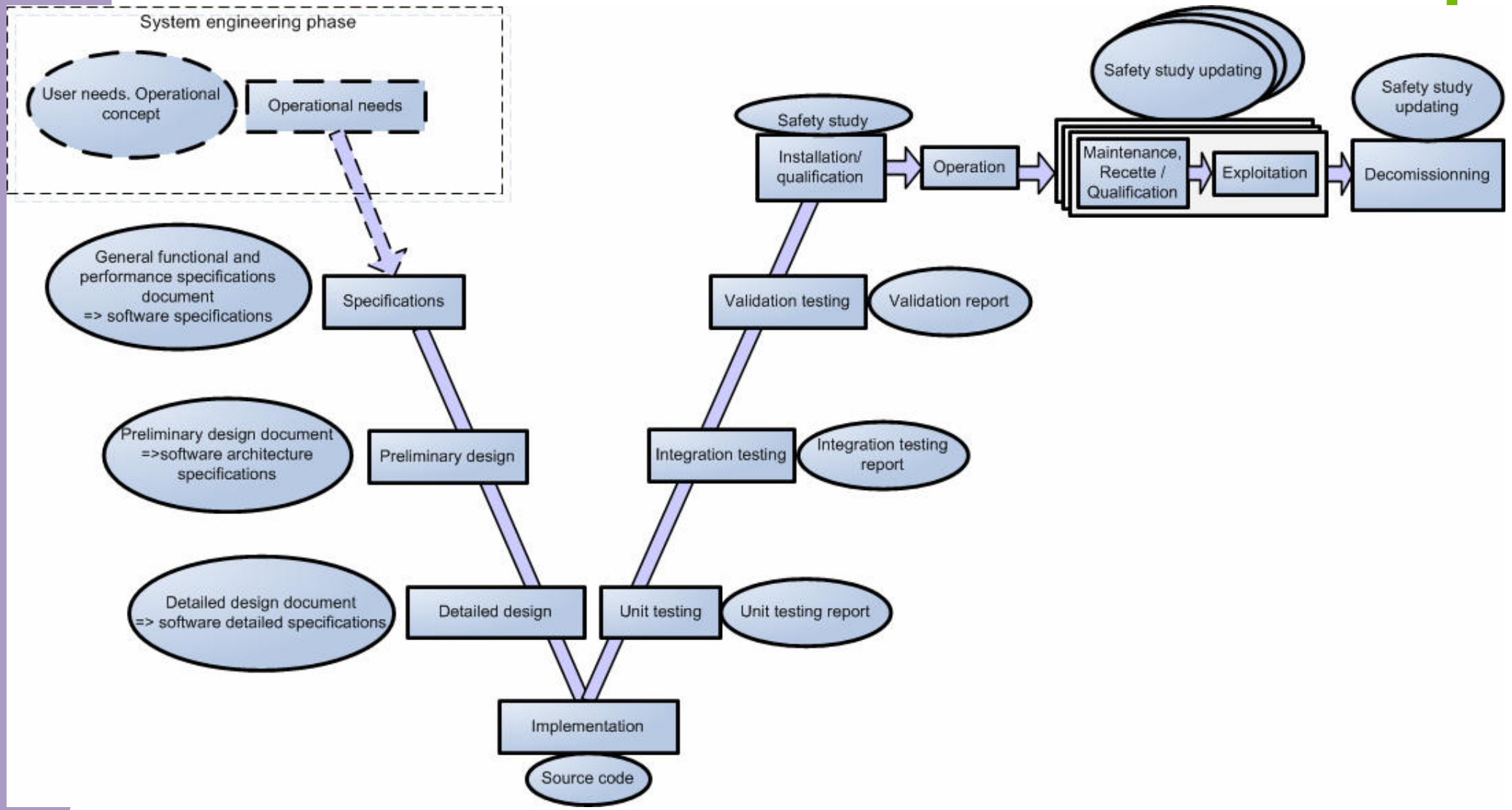
2) Nature of software modification

A software modification is said MAJOR in either following case :
- internal sw architecture is significantly affected or,
- dynamic behaviour of the sw functionality is significantly affected or,
- the number of software functionalities is significantly increased.

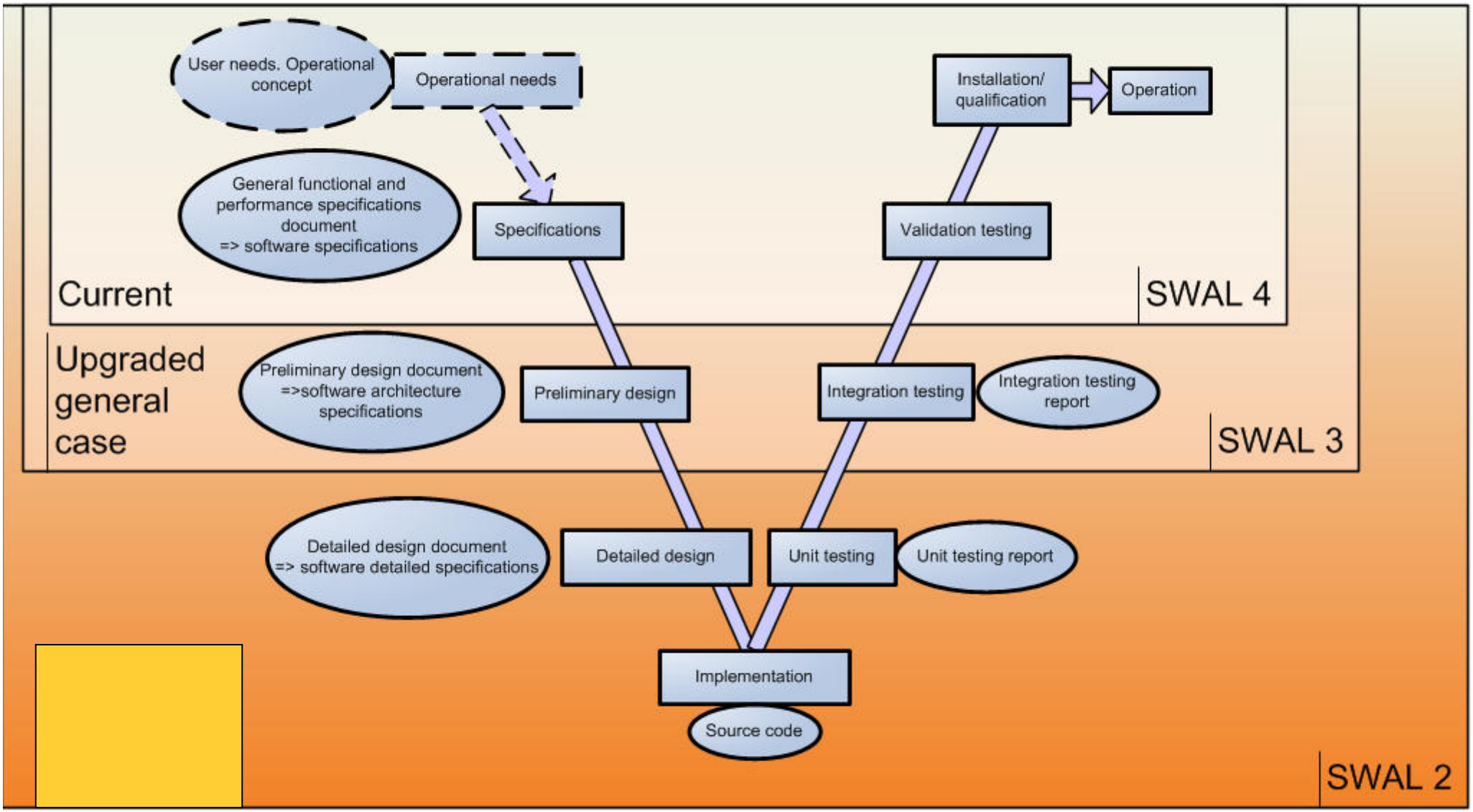
A software modification is said MINOR otherwise.

Confidence level satisfaction

Activities along the V cycle



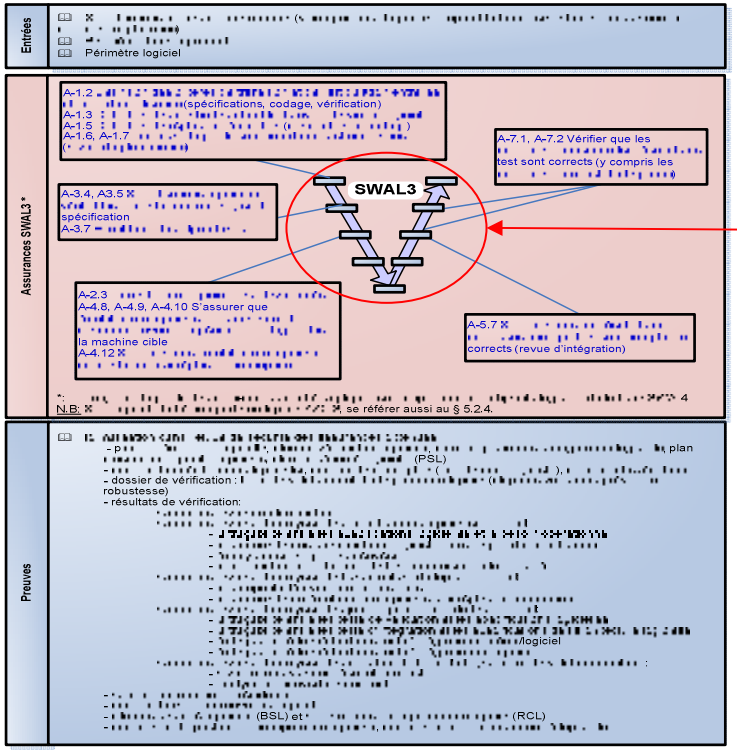
Software confidence level gradation policy

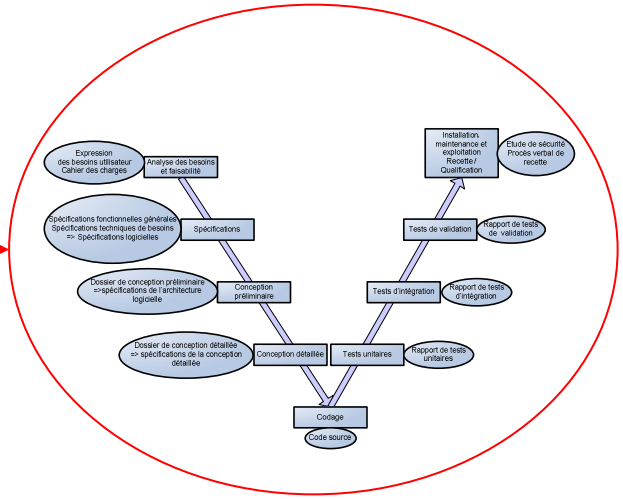


Guide Leaflet
Confidence level satisfaction leaflet structure

Definition of activites and expected evidence along the V cycle for each confidence level

- work sharing (site, supplier…)





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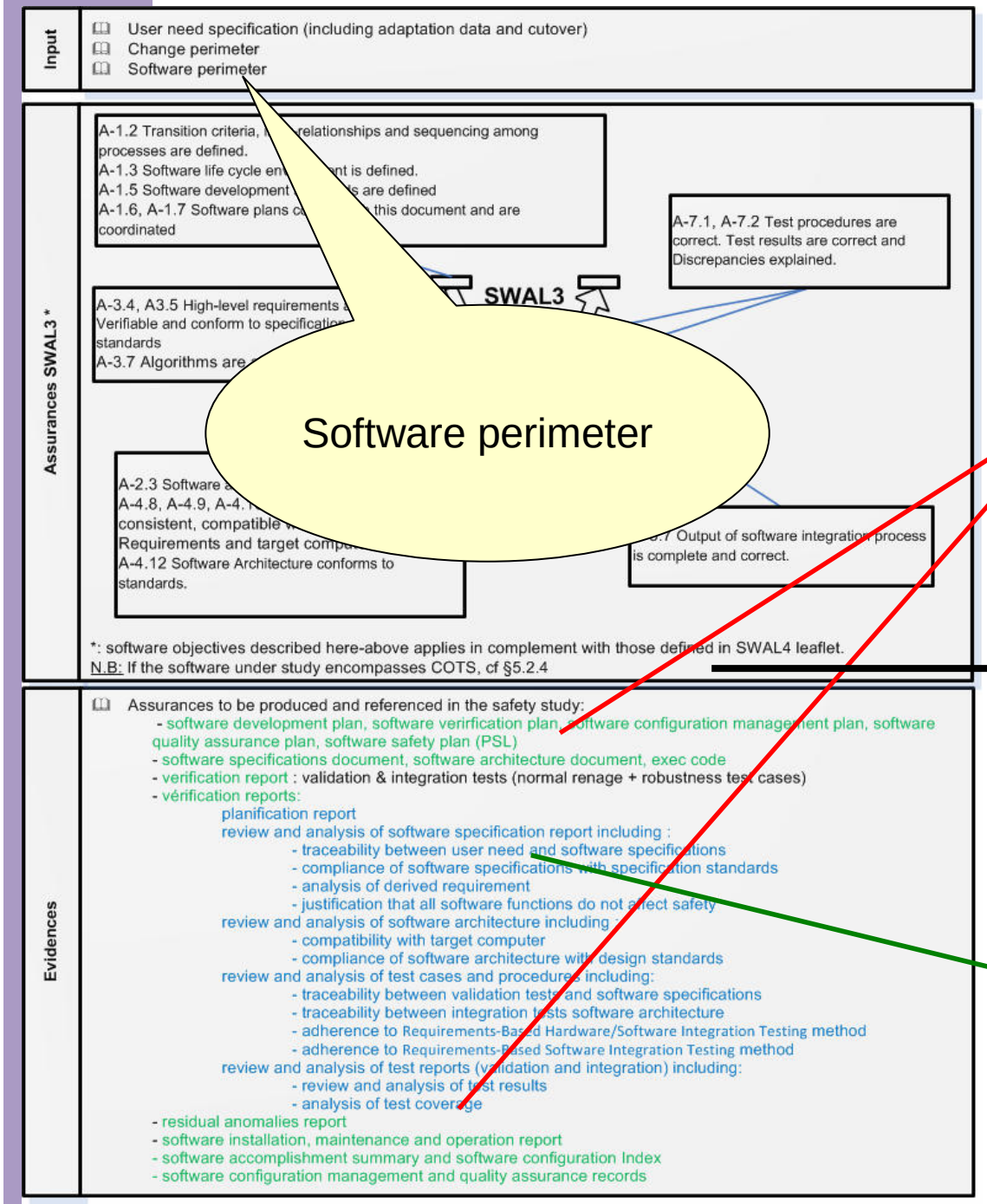
Confidence level satisfaction leaflet



Annex 1

Software life cycle data (ED12B)

COTS considerations (ED109)

Annex 2

Software verification (ED12B)

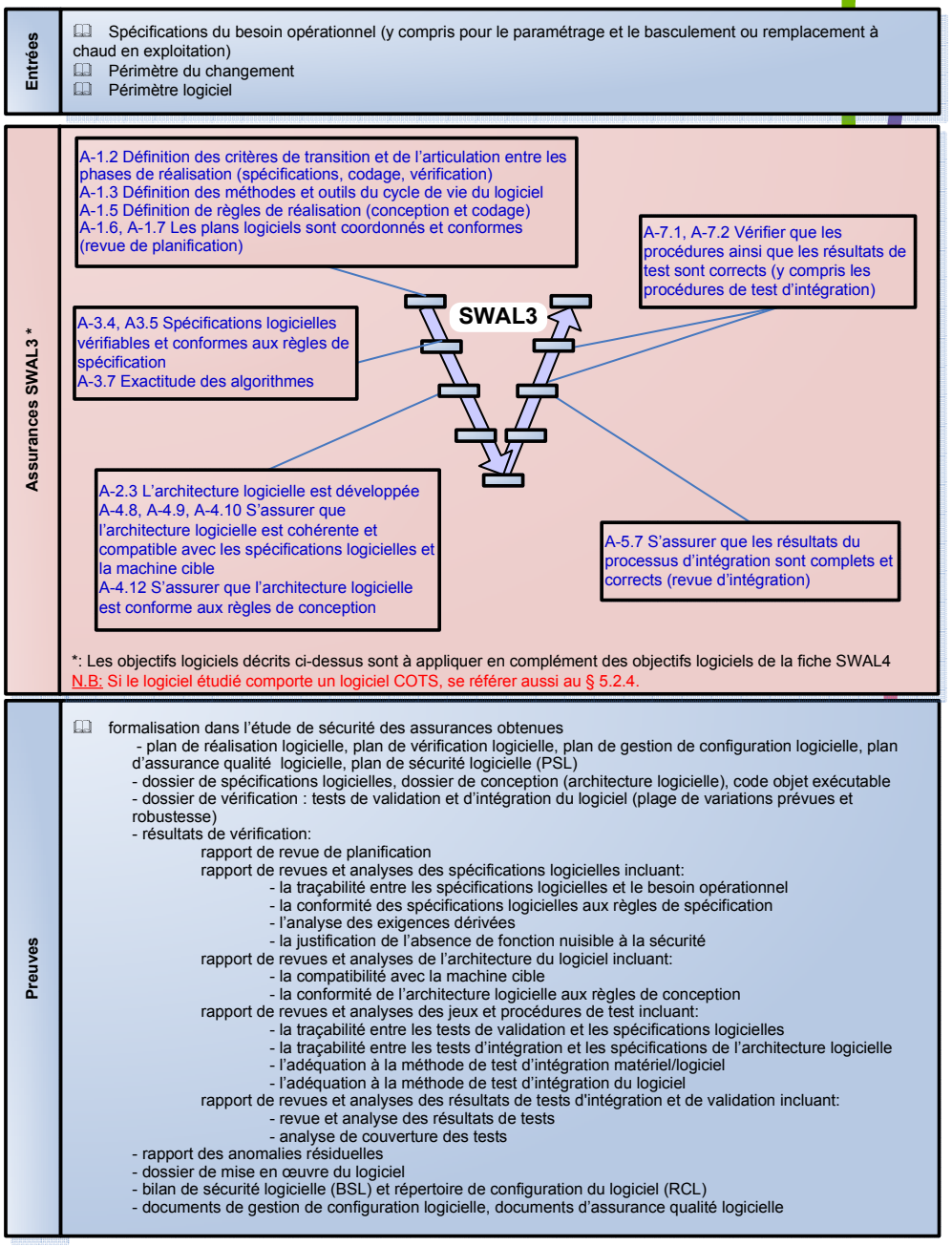
Guide METLOG : COTS Aspects (ED109)

Equivalence Confidence level/In service experience	
Required software Confidence level	**In service experience with management of deficiencies**
Upgraded	1 year without safety failure
SWAL 2	1 year without safety failure
SWAL 3	6 months without safety failure
SWAL 4 or Current	No in service experience required

- Software confidence level Satisfaction:
  - Either the COTS providers artifacts are sufficient (when completed with necessary assurances for operations)
  - Or when insufficient it is compensated by:

    Reverse-engineering or

    In service experience.



Guide METLOG : COTS aspects snooping around

Whatever COTS that is introduced into an ATM/CNS software, a minima, the following assurances are provided :

- Validity of COTS sw specifications
- verification of COTS sw specifications
- Introduction of COTS does not adversely affect safety
- Configuration management

At COTS level, additional level of reverse-engineering or EXP to be achieved for a given ATM/CNS software is indicated below

SW Confidence level required / Type of Introduced SW COTS	Upgraded	SWAL3	SWAL2
COTS software library			(validity and verification of requirements of library with SC and code review) Or EXP 1 year
Software components COTS (module, firmware, driver, OS, etc)			(validity and verification of preliminary and detailed design requirements, SC and code review) or EXP 1 year
Applicative software COTS	(validity and verification of preliminary design) Or EXP 1 year	validity and verification of preliminary design) Or EXP 6 months	(validity and verification of preliminary and detailed design requirements, SC and code review) or EXP 1 year

EXP : in service experience with no safety issue for a given software version
SC : structural coverage

Software COTS acquisition

Vade-mecum at contract level

- Specify to the provider the required software assurances for DSNA.
- When the confidence level is not determined a the date of the contract signature (as dependent on the retained architectural solution)
  - Indicate to the provider the confidence level allocation and satisfaction DSNA processes
- Possible DSNA software audits on site with respect to the software criticality.

DSNA software Hot spots

Legacy software treatment :

- Limited current architectures show that some legacy software are directly contributing to SC2 HAZ and therefore would be SWAL2 now if redevelopped.
- The NSA is very demanding on the level of assurances to be provided for legacy (SWAL3-like or SWAL2-like)
- DSNA has some difficulties to substantiate the confidence level satisfaction.

COTS treatment :

- COTS safety acceptance criteria is based on either reverse engineering techniques or EXP. What else ?
- Software common modes of failures can lead to high SWAL in network (drivers or routeurs) when the architectures are not diversified.

No adverse safety effect from COTS

- difficulty to list all COTS functionalities (OS for instance) and deactivate/remove/passivate them.
- the strategy is to perform endurance testing.

Already flawed architectures

- ARTAS used as primary means for the ASP. The HAZ ‘Undetected corruption of ASP’ is deemed SC2, even SC1 (FABEC brainstorming) where ARTAS is shown to be SWAL3.

Questions ?

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