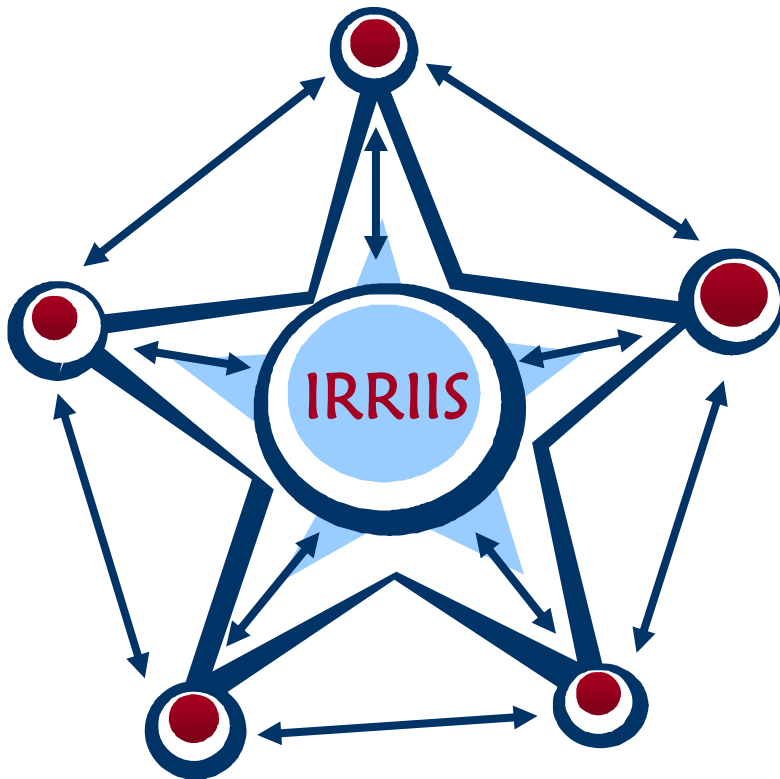


Increase of power system survivability: Decision Support Tool “CRIPS” based on Network Planning



Christine Schwaegerl
Olaf Seifert

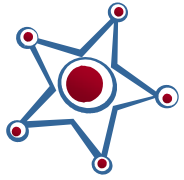
SIEMENS

Robert Buschmann
Hermann Dellwing
Stefan Geretshuber
Claus Leick

iABG

IRRIIS - FP6-2005-IST-4

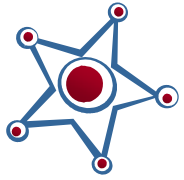




Decision-Support Tools for the Power Domain

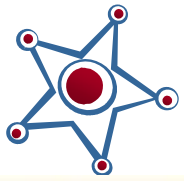
What we mean is a tool which can provide suggested (control) actions (to the operator)

1. Most approaches use a **physical model** of the system (online simulation)
2. Other approaches use **data-mining** techniques, when the underlying problem needs accurate classification or detection of patterns
3. Our approach presented here is to formalize and capture the human expert knowledge and then build a tool based on “expert-system” techniques (**rule-based systems**)



The Decision-Support Tool “CRIPS”

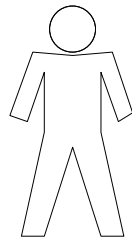
- Acronym: **C**risis Planning and **P**revention **S**ystem
 - CRIPS is a Knowledge Based Expert System
 - CRIPS is one of the “MIT add-on Components” developed within the IRRIS Project
 - CRIPS supports Operators by
 - Assessing of the current situation based on
 - dependency structures
 - insights gained during exercises
 - experiences from incidents
- } = **Expert Knowledge**
- Suggesting Actions/Decisions based on this assessment



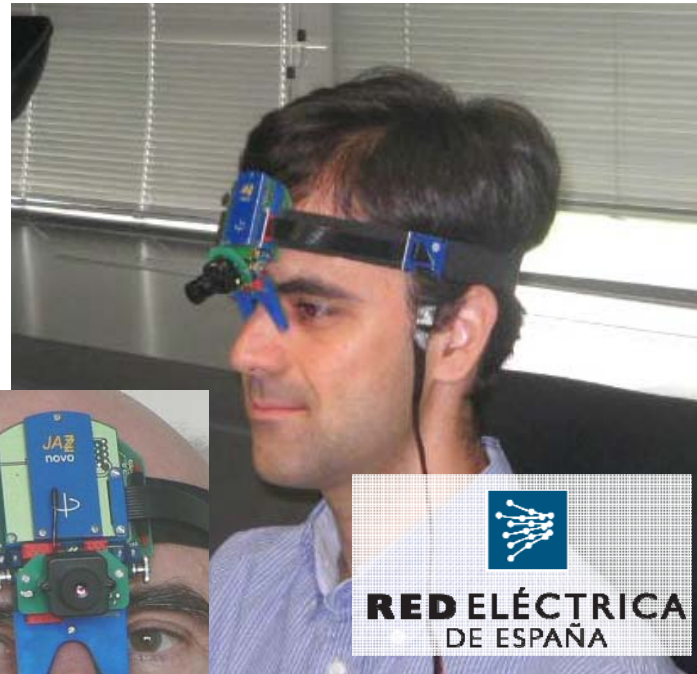
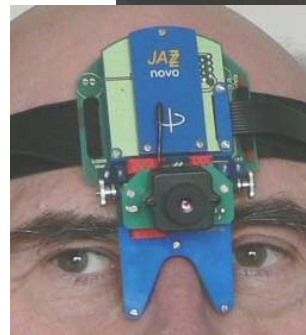
Tasks of a Power System Operator

command

Measurement of Operator's Utilisation



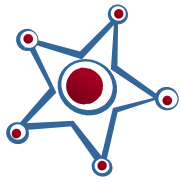
Operator



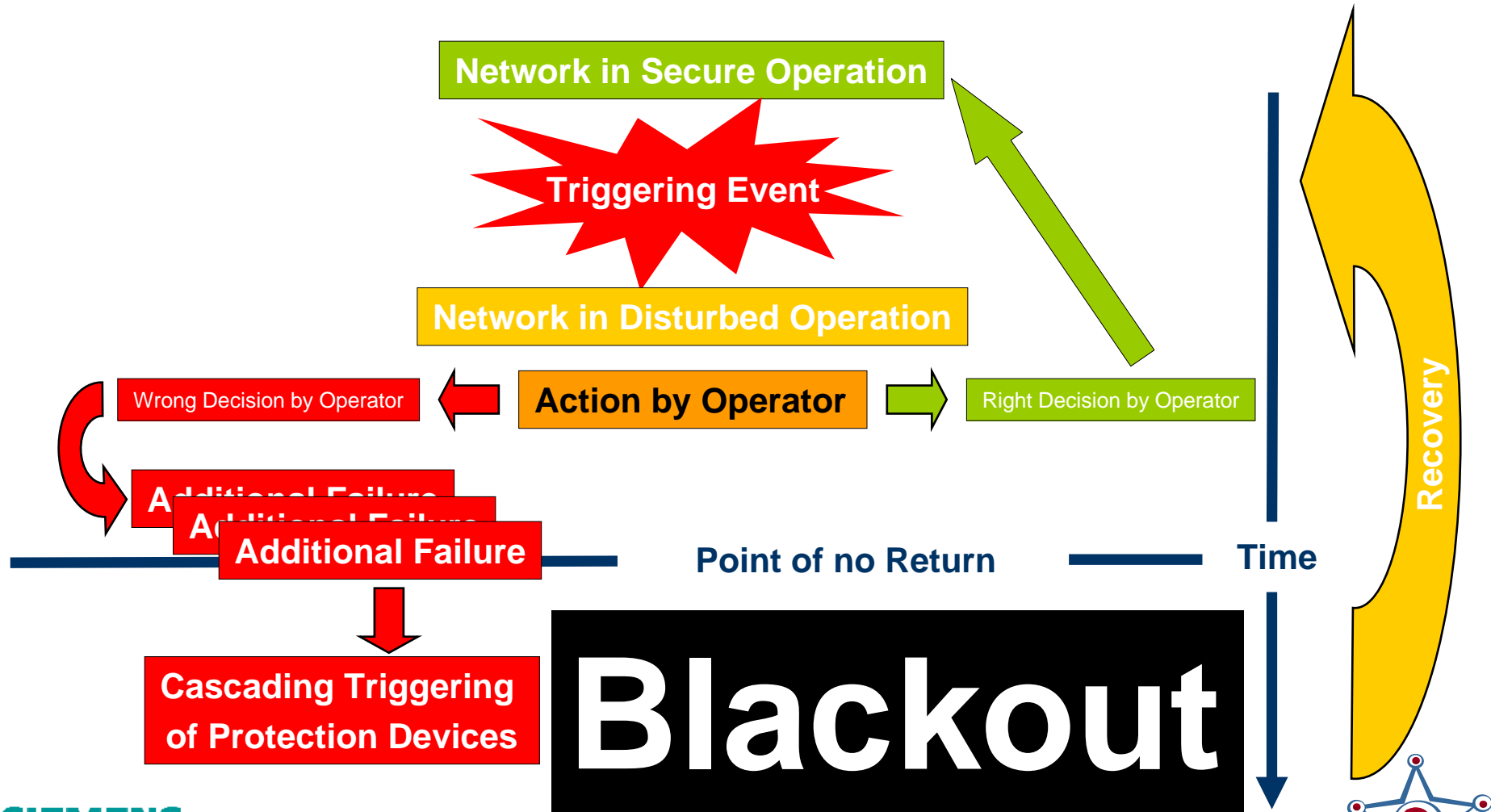
control

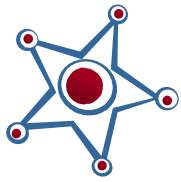
archive & visualise

monitor & collect data

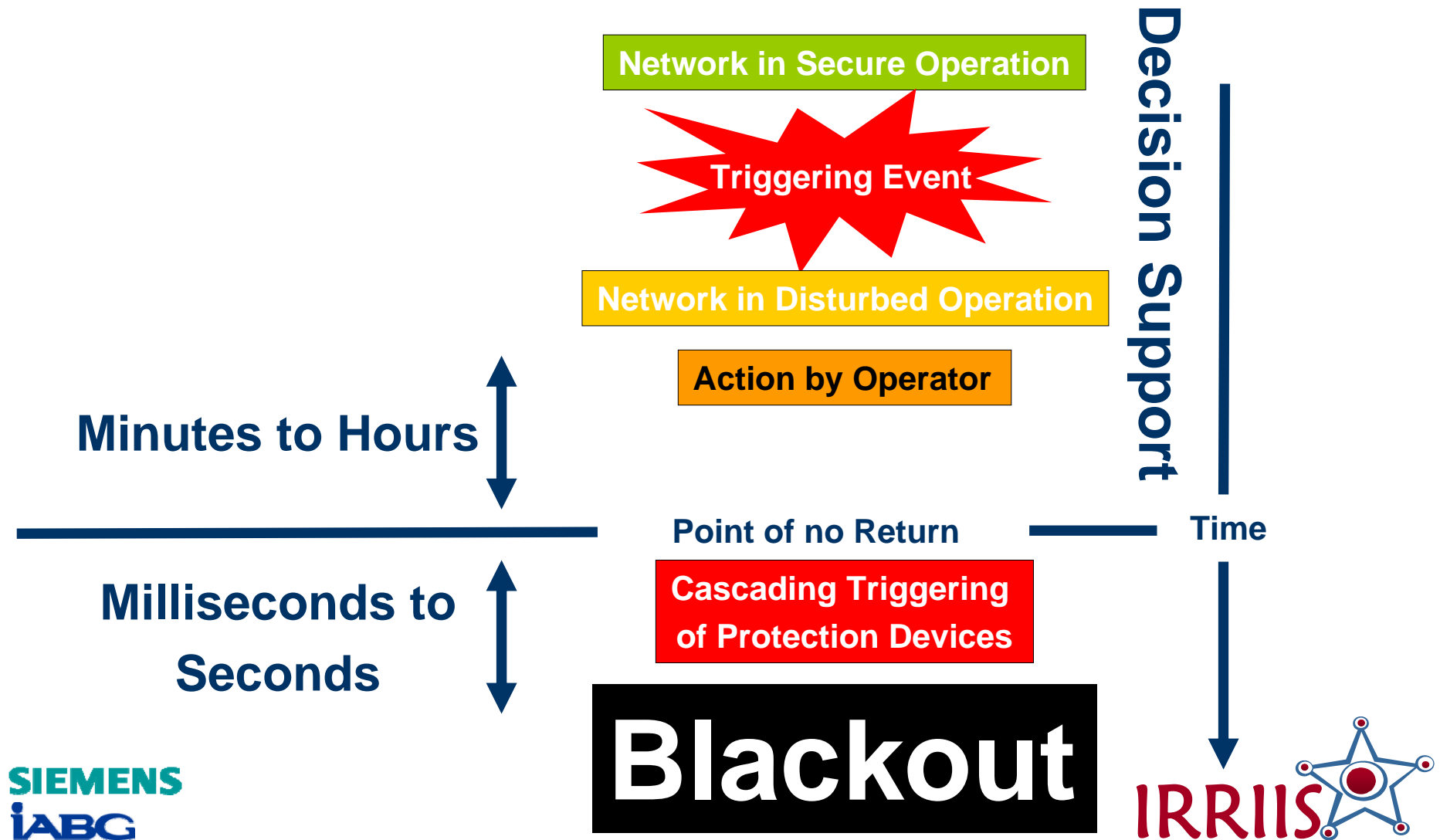


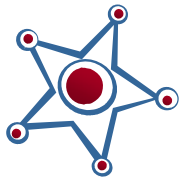
Emergence of a Power Blackout



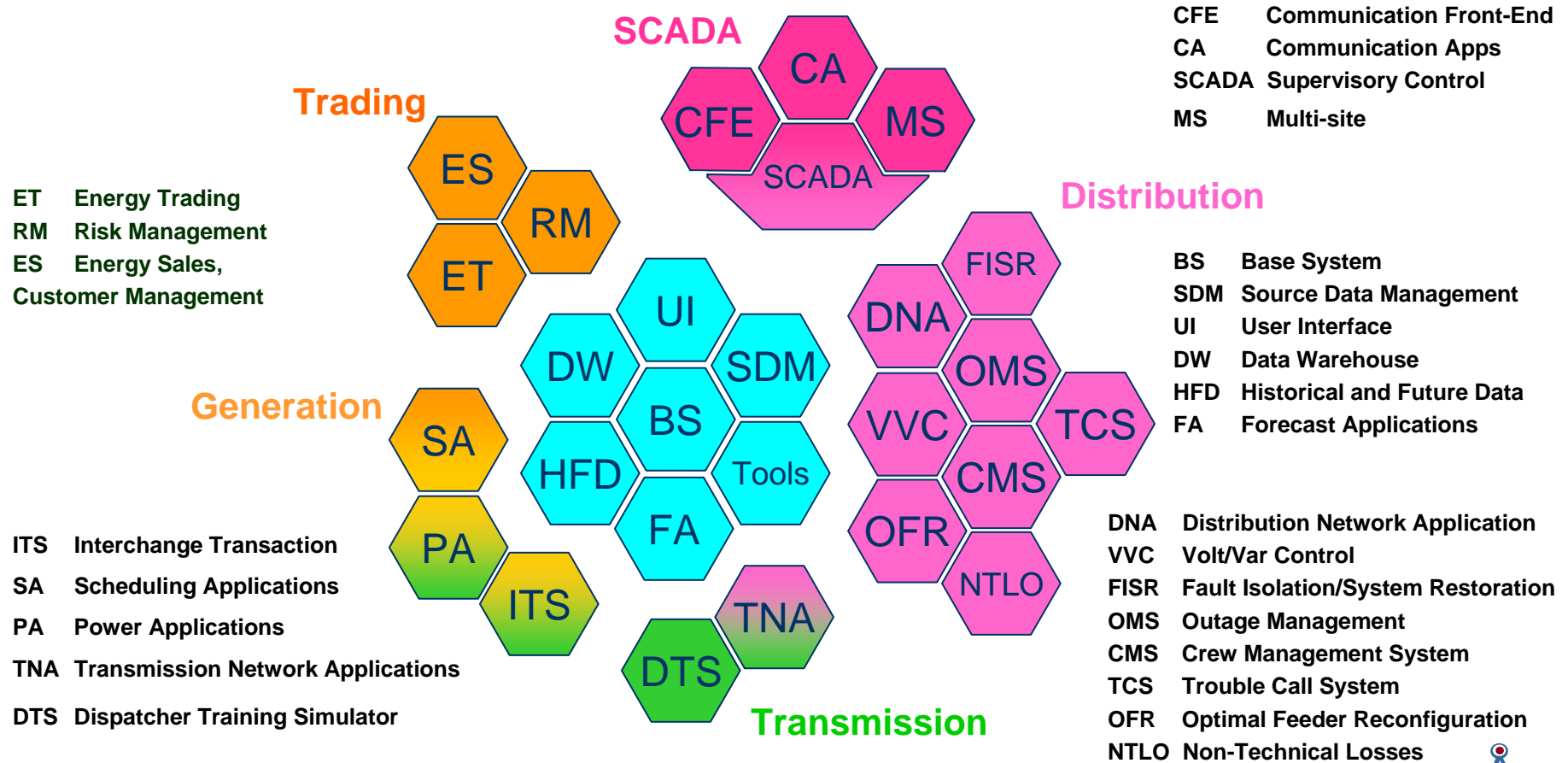


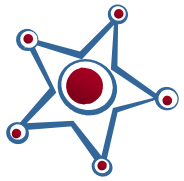
Reaction Times



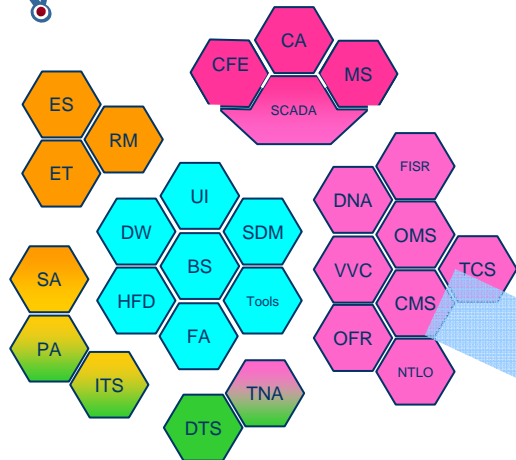


Input for Power System Operator



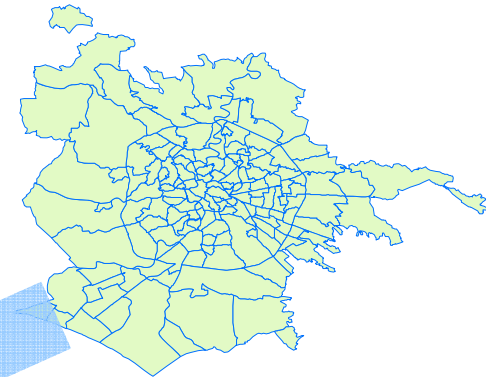


Power System Operator Behaviour

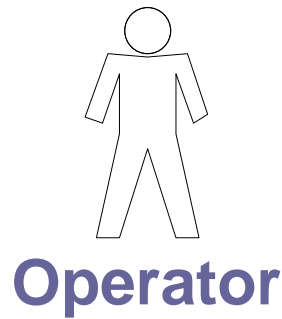


IT-Systems

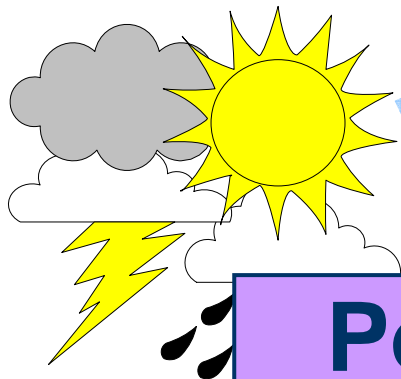
Decisions



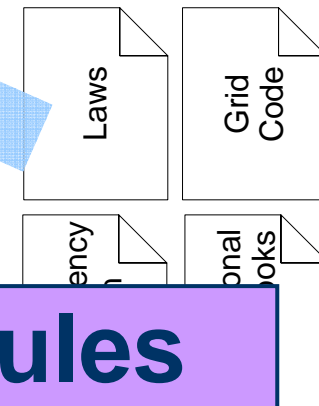
Geographic Realities



Operator



Environmental Conditions

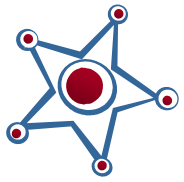


Guidelines

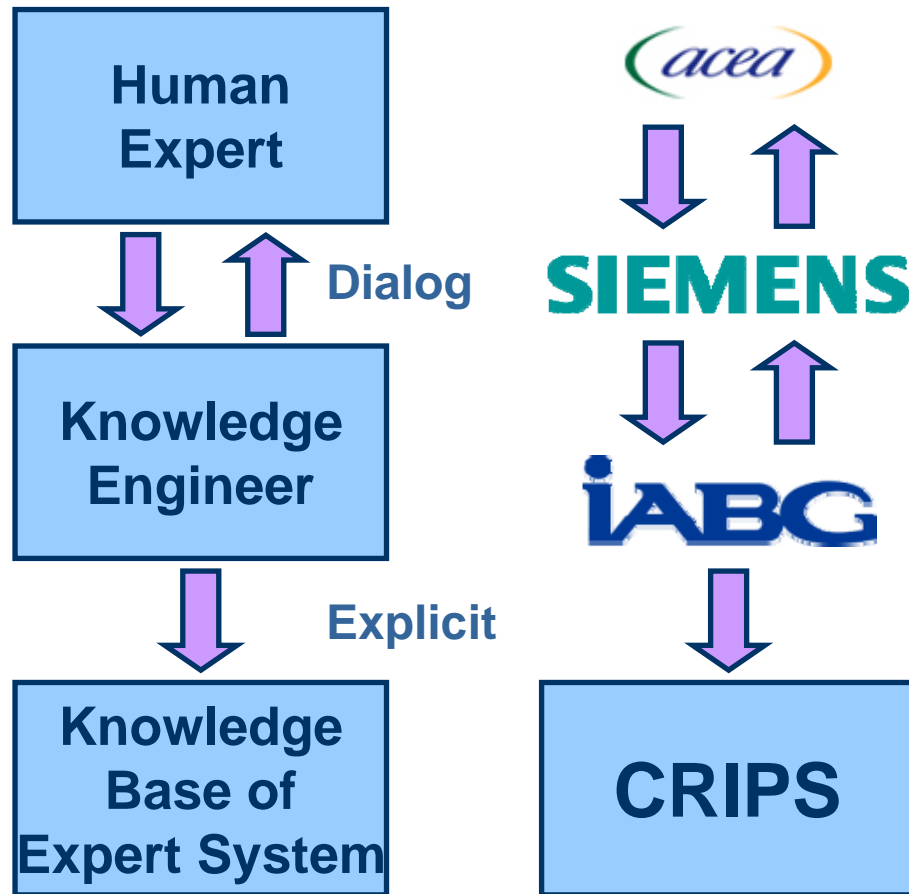
Potential Input for Rules



Historical Incidents

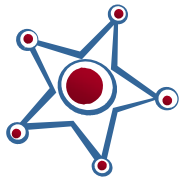


Knowledge Engineering Process in the IRRIS Project

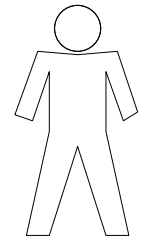
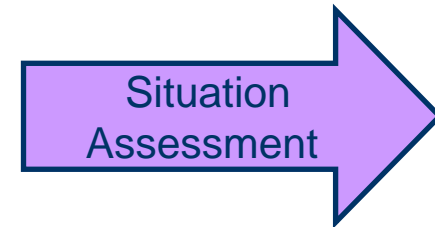


1. Develop a Scenario (Topology)
2. Build a Simulation Model
3. Acquire "Expert Knowledge"
4. Formalise & Model Knowledge
5. Validate Approach

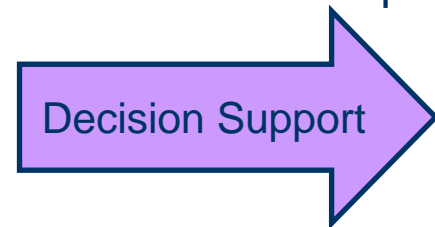


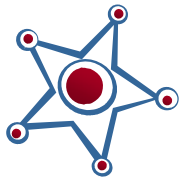


CRIPS – Expert System

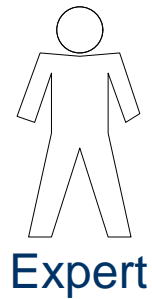


Operator





CRIPS – Expert System



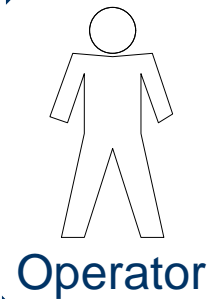
one-time

Expert Knowledge

Rules

Situation Assessment

CRIPS



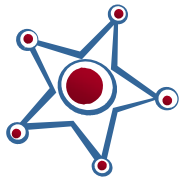
continuously

SCADA

Present Situation

Facts

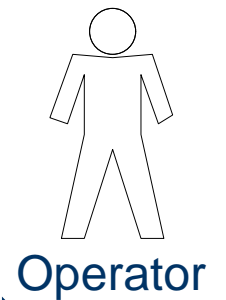
Decision Support



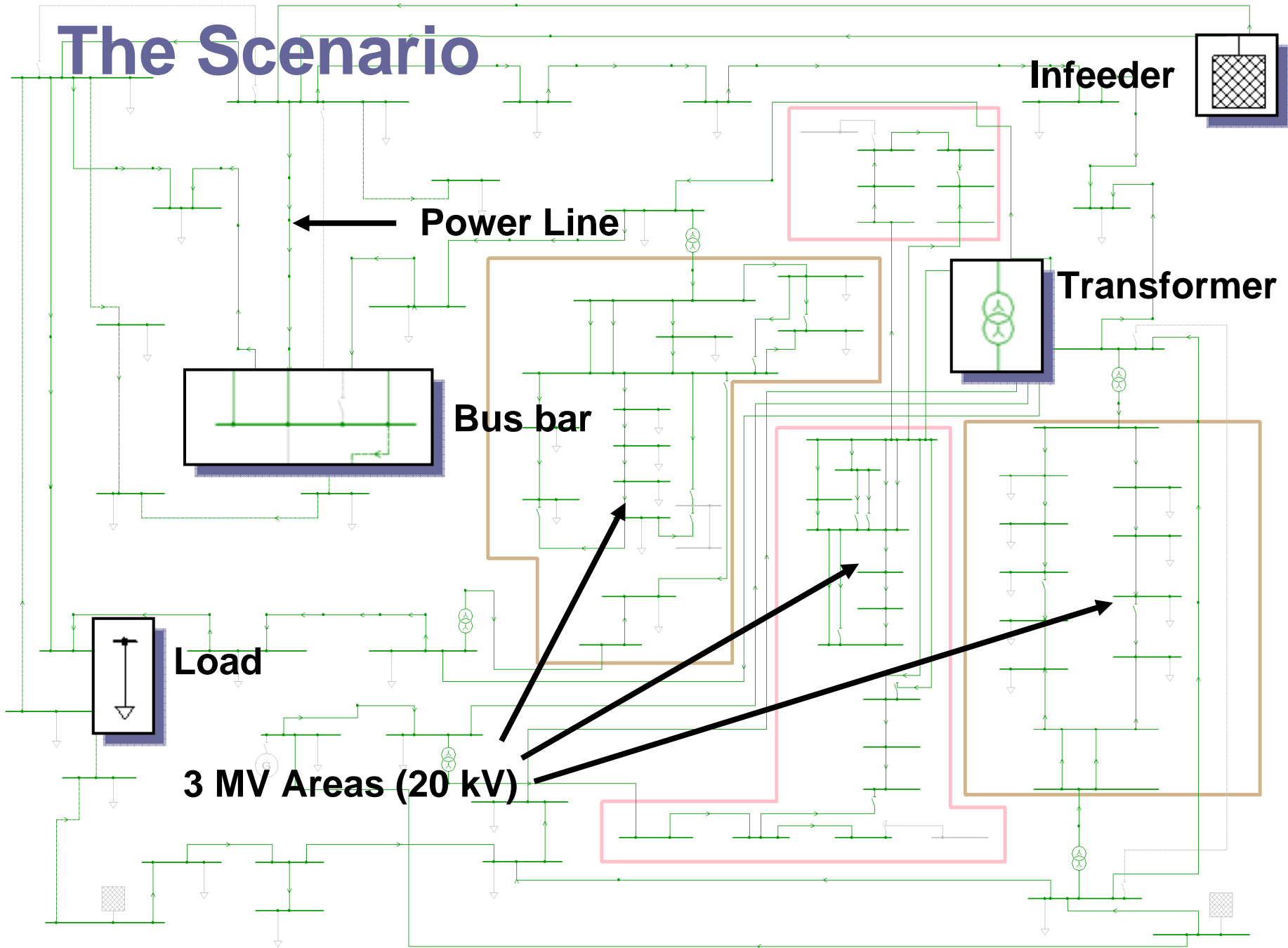
CRIPS – “Demonstration”

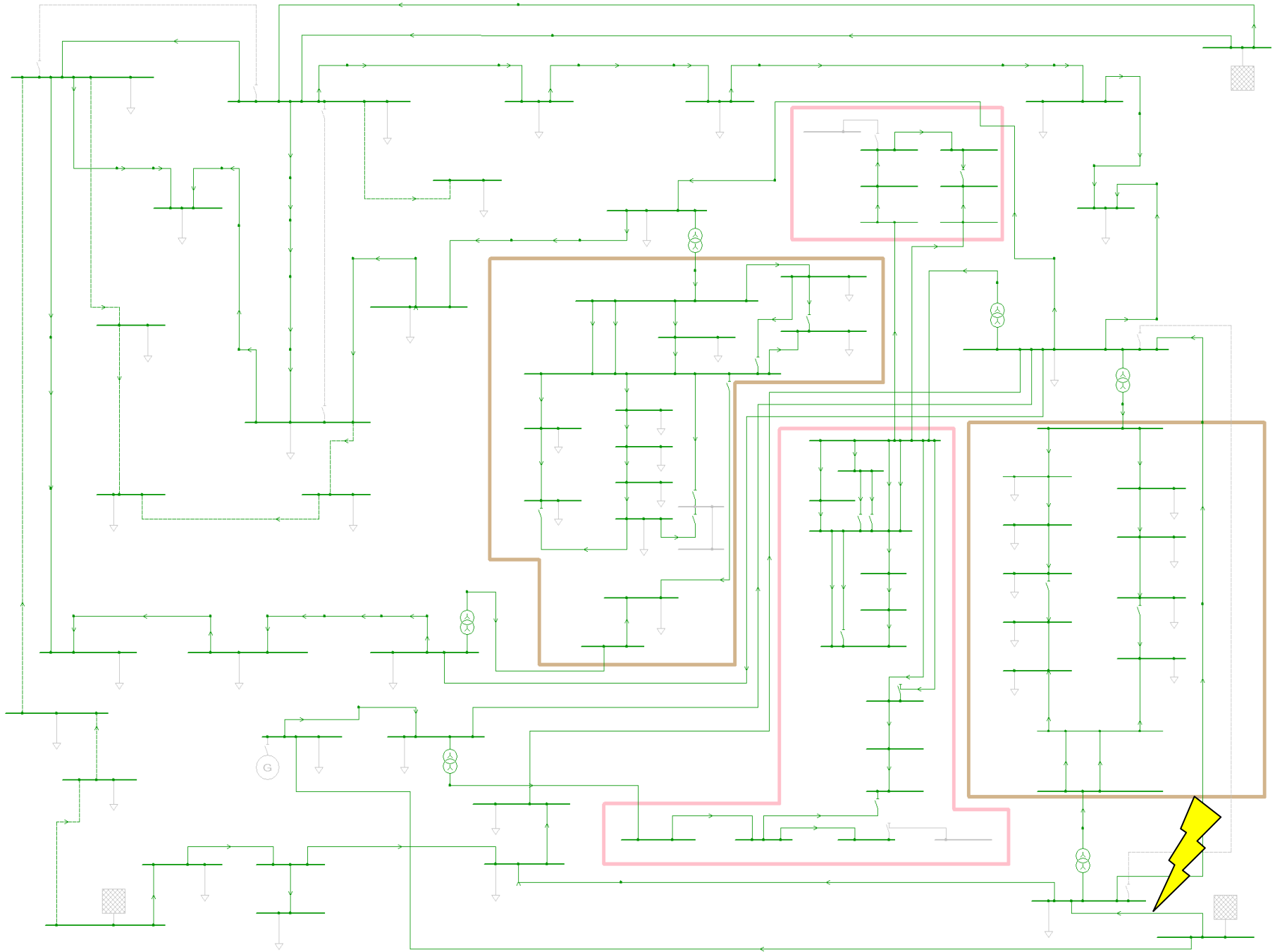


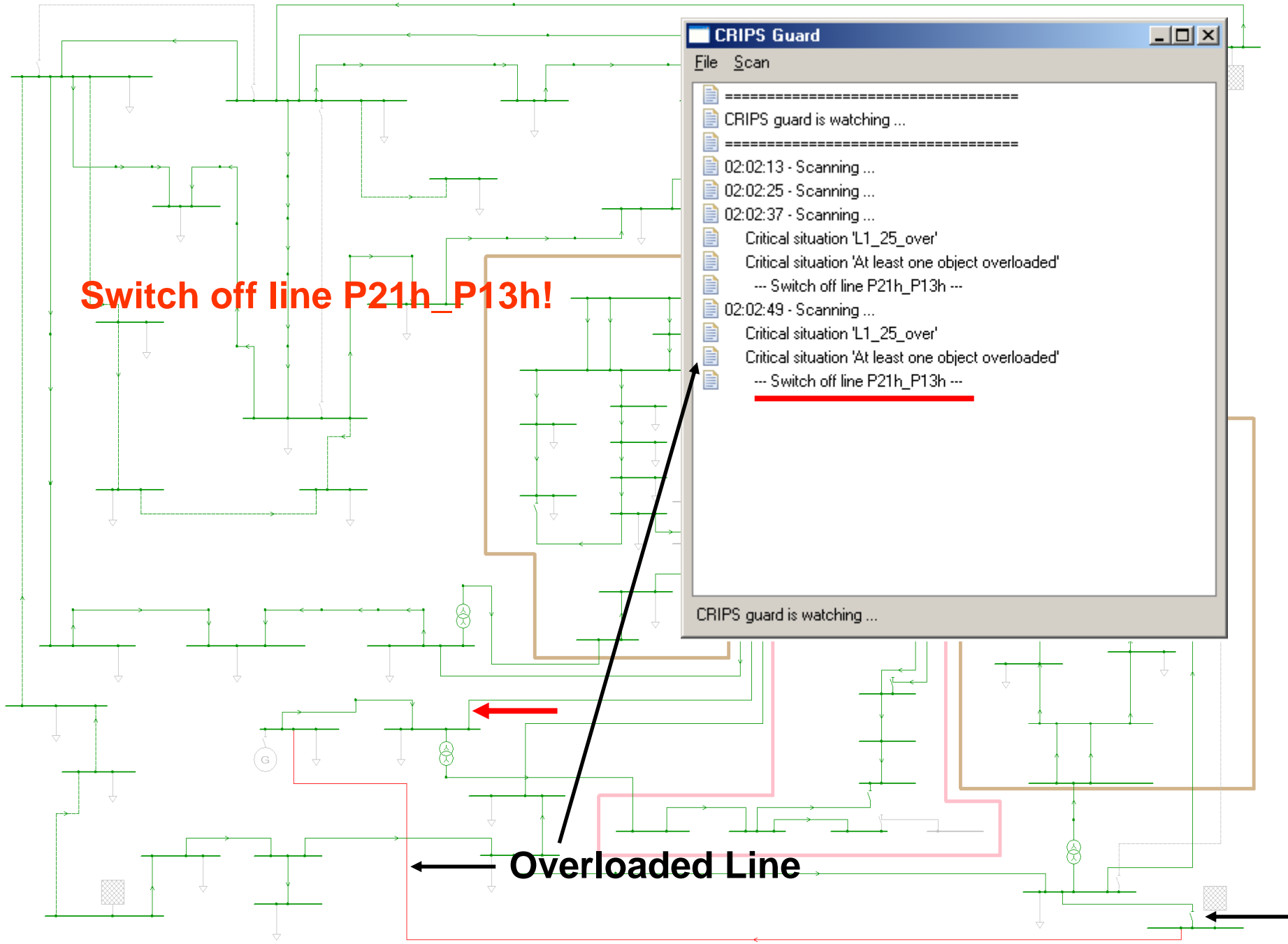
Sincal



The Scenario







Switch off line P21h_P13h!

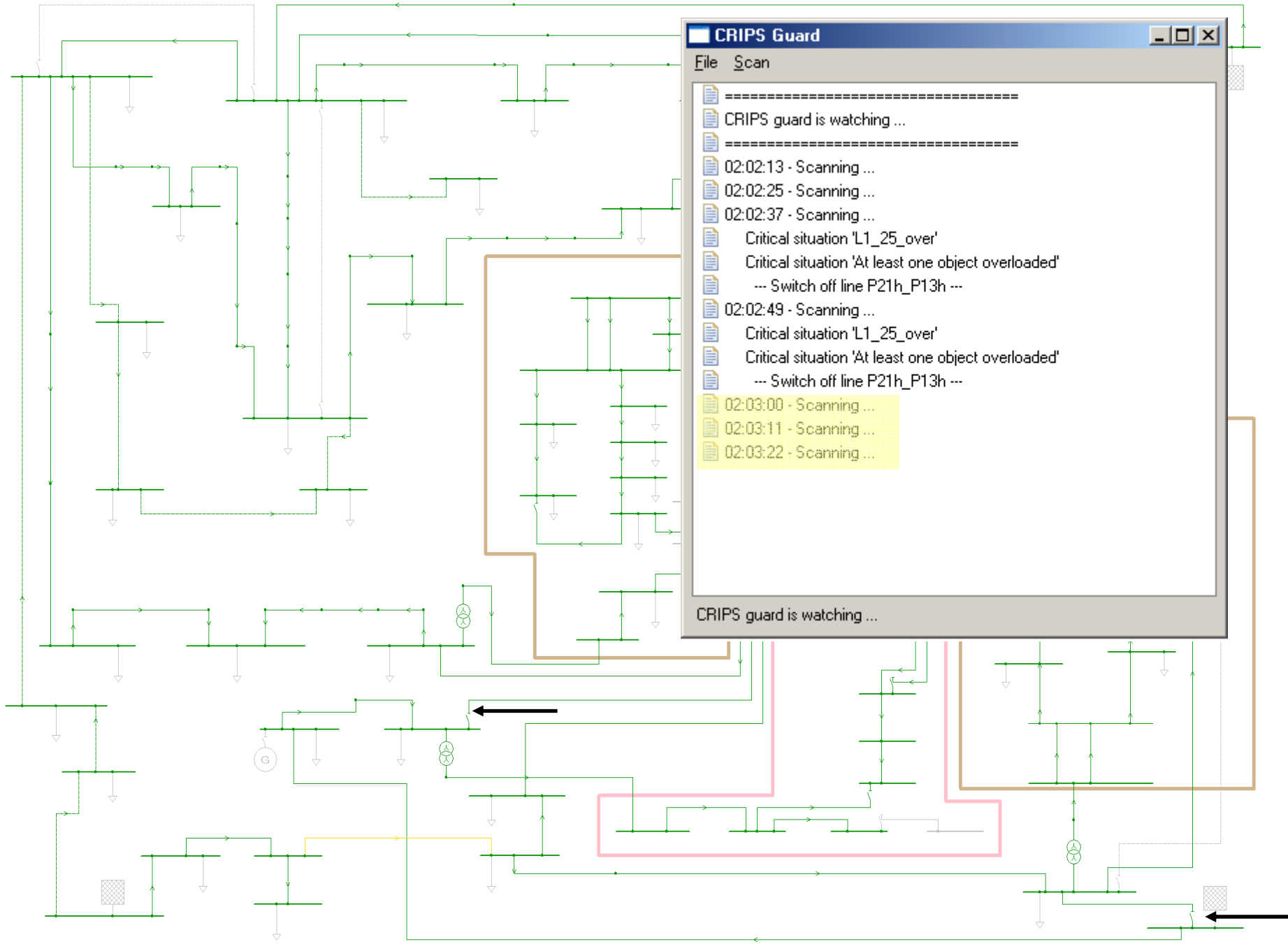
Overloaded Line

CRIPS Guard

File Scan

-
- CRIPS guard is watching ...
-
- 02:02:13 - Scanning ...
- 02:02:25 - Scanning ...
- 02:02:37 - Scanning ...
- Critical situation 'L1_25_over'
- Critical situation 'At least one object overloaded'
- Switch off line P21h_P13h ---
- 02:02:49 - Scanning ...
- Critical situation 'L1_25_over'
- Critical situation 'At least one object overloaded'
- Switch off line P21h_P13h ---

CRIPS guard is watching ...

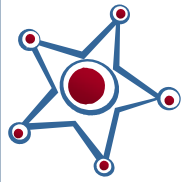


CRIPS Guard

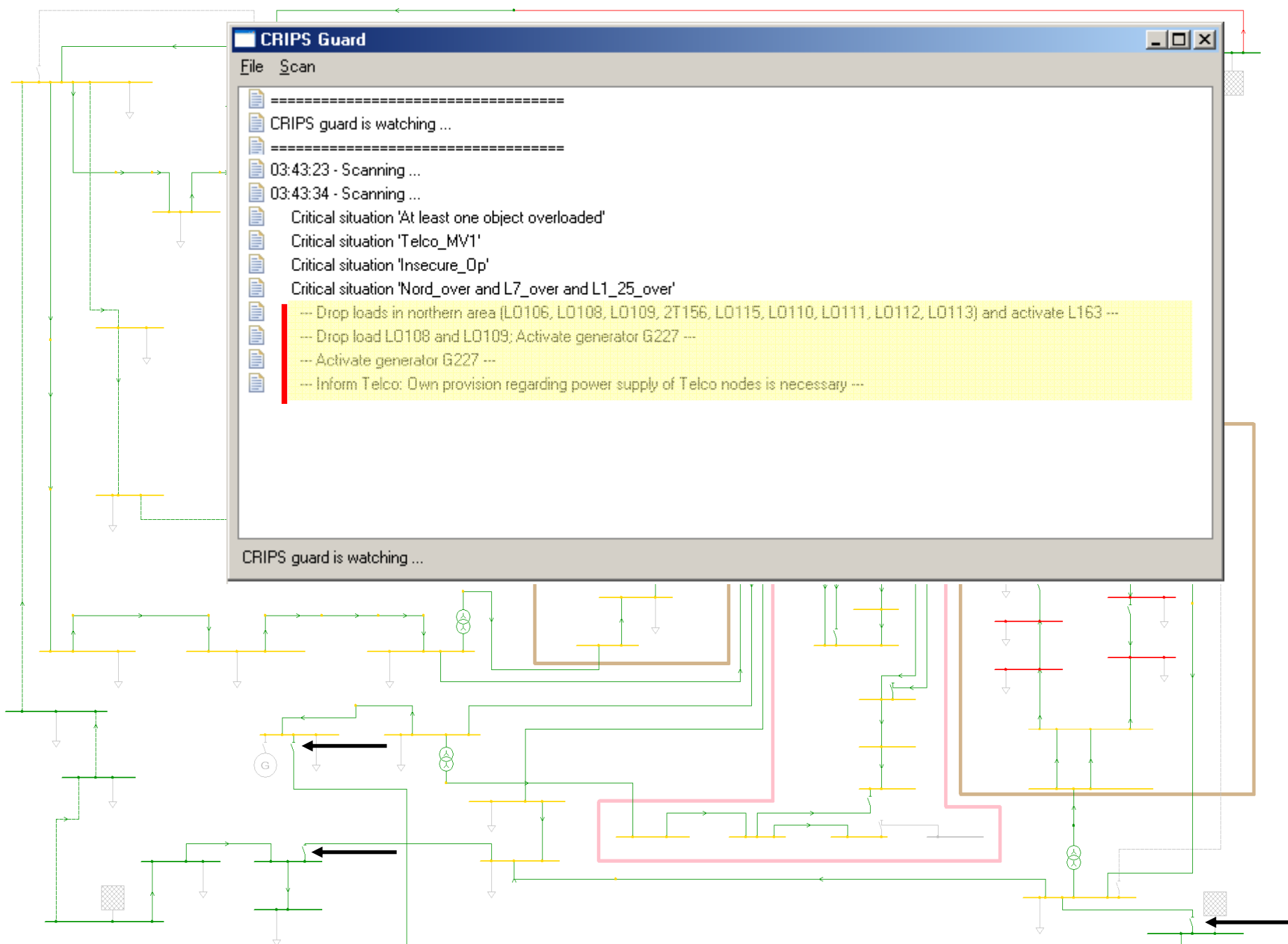
File Scan

- =====
- CRIPS guard is watching ...
- =====
- 02:02:13 - Scanning ...
- 02:02:25 - Scanning ...
- 02:02:37 - Scanning ...
- Critical situation 'L1_25_over'
- Critical situation 'At least one object overloaded'
- Switch off line P21h_P13h --
- 02:02:49 - Scanning ...
- Critical situation 'L1_25_over'
- Critical situation 'At least one object overloaded'
- Switch off line P21h_P13h --
- 02:03:00 - Scanning ...
- 02:03:11 - Scanning ...
- 02:03:22 - Scanning ...

CRIPS guard is watching ...



2. Scenario

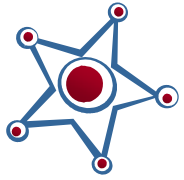


CRIPS Guard

File Scan

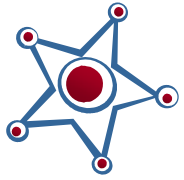
-
- CRIPS guard is watching ...
-
- 03:43:23 - Scanning ...
- 03:43:34 - Scanning ...
- Critical situation 'At least one object overloaded'
- Critical situation 'Telco_MV1'
- Critical situation 'Insecure_Dp'
- Critical situation 'Nord_over and L7_over and L1_25_over'
- Drop loads in northern area (L0106, L0108, L0109, 2T156, L0115, L0110, L0111, L0112, L0113) and activate L163 ---
- Drop load L0108 and L0109; Activate generator G227 ---
- Activate generator G227 ---
- Inform Telco: Own provision regarding power supply of Telco nodes is necessary ---

CRIPS guard is watching ...



Conclusions

- The weakest part of the control chain is the human operator
- Advanced technology is taking load from the operator
- Not every problem can be described by physics
- So an expert system can support decision and strategic assessment
- Specific suggestions still have to be validated by online simulation
- Very good relationship “simplicity – efficiency”



Thank You!

Questions?