Réponse rapide de groupes hydroélectriques
(STEP Gilboa, Israël)

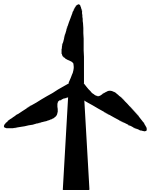
Hydro 21 : Focus Hydro

4 décembre, 2019

Introduction

Flexibility

- Electrical grids are destabilized by intermittent energies



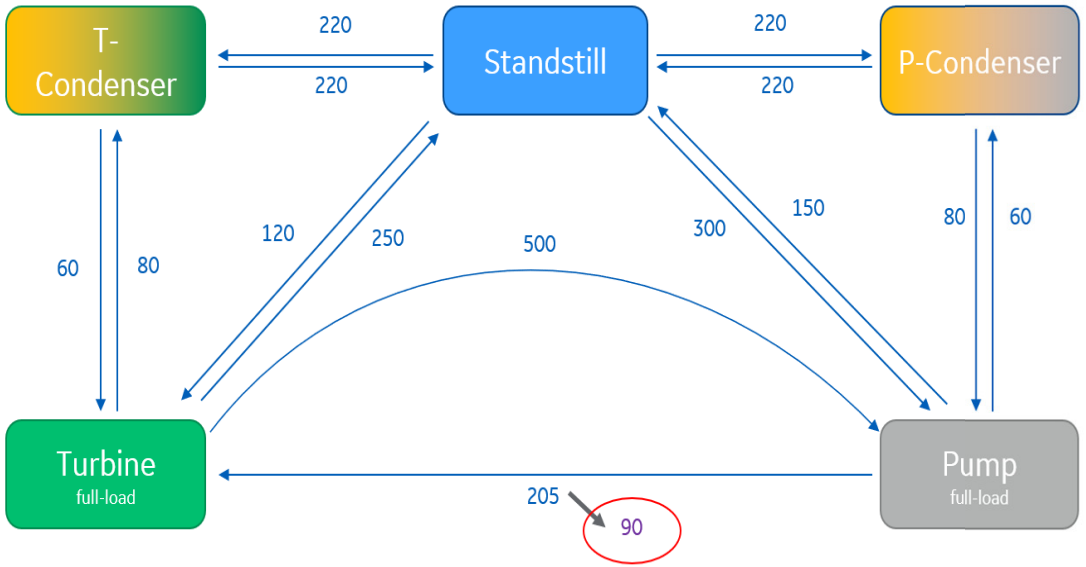
- Hydro can support by starting the machines faster and more frequently

- And obtain new revenues

Temps de transition

Flexibility

Typical Transition Times (in second) for Fixed Speed Hydro Storage (STEP)

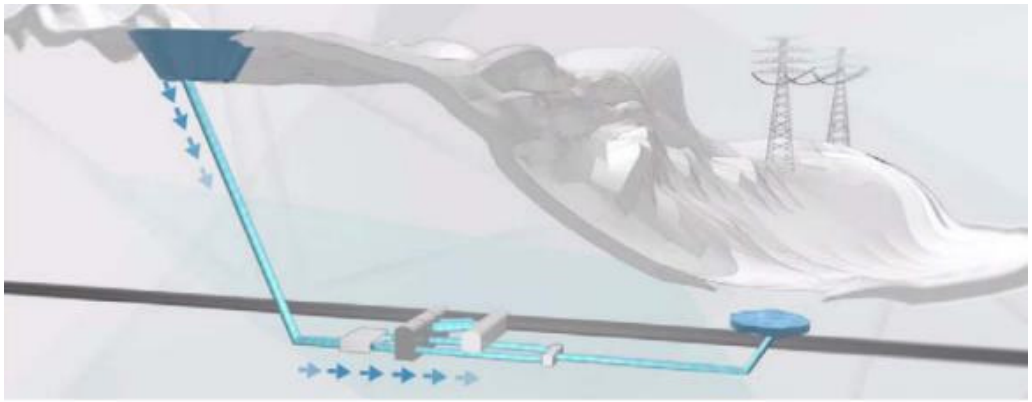


Gilboa project demand : /2 typical transition times

L’integration de Renouvelables dans un reseau isolé

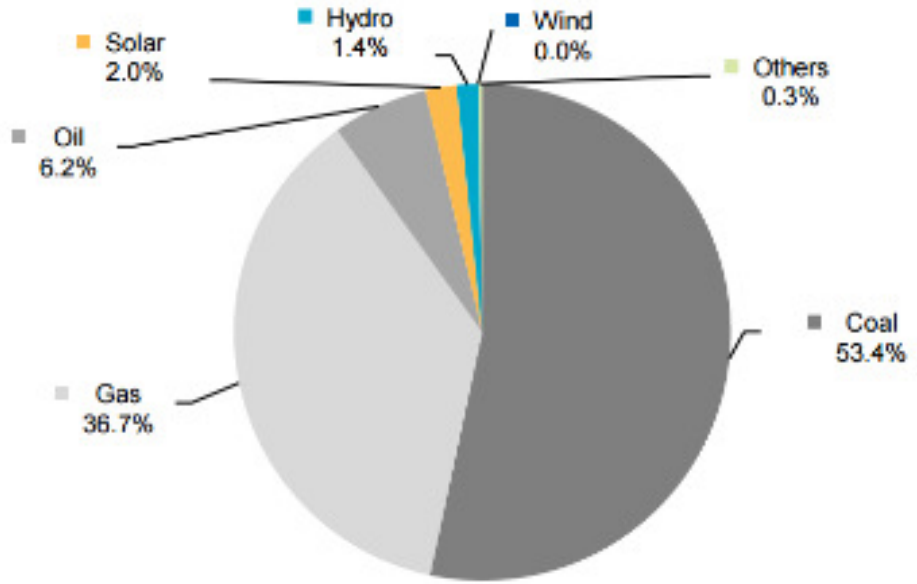
Israël

- Isolated grid needing power independence
- Hydroelectricity to help meet energy demands and increase grid reliability (Hydropower currently accounts for just 7 MW)
- Goal of generating 17% of the country’s electricity from renewable energy sources by 2030



Source: IOP

Generation mix, 2015 (65 TWh)



Source: IHS

Gilboa, Israël

Une plus grande flexibilité pour intégrer davantage de Renouvelables dans un reseau isolé

90 sec
transition from full pump to full generation

18 year
O&M contract

Challenge

Isolated grid needing power independence and strong reliability for the installation of the 1st PSP in the country, managed by private investor

GE Solution

Full turnkey solution

Electromechanical equipment contract incl. Engineering, Procurement and Construction

Full Operation and Maintenance for :

- Improved performance
- Reduced operational risks

Operator: PSP Investment Ltd

Output: 300 MW

Head: 500 m

Speed : 750 rpm

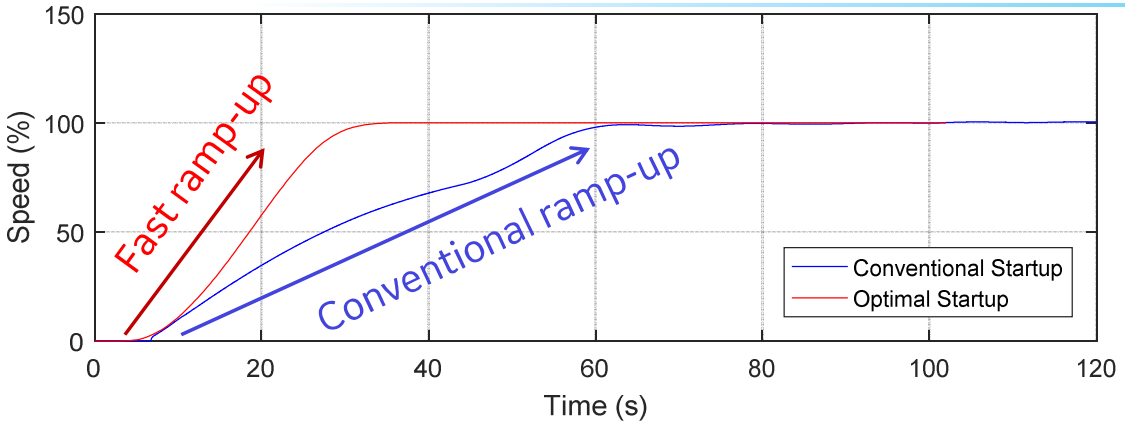
Turbine technology: Single-stage

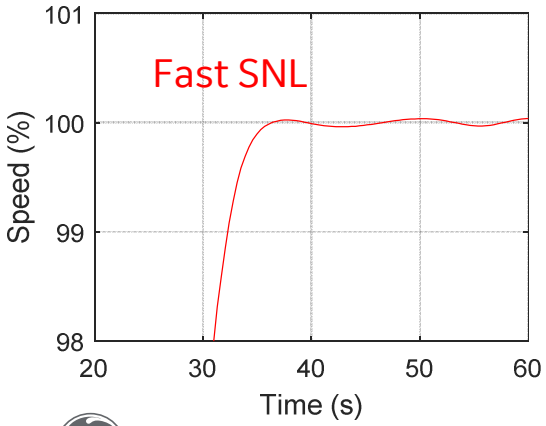
Generator technology: fixed speed

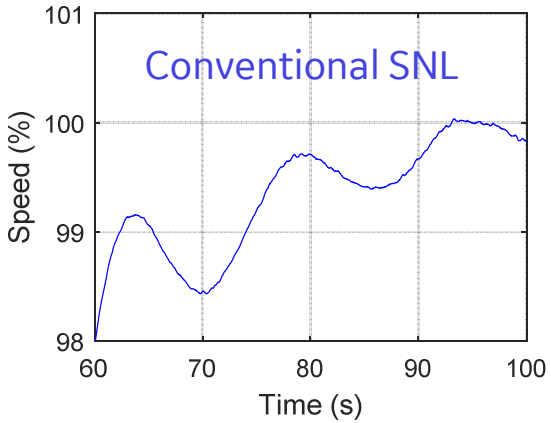
Scope

- 2 x 150 MW pump turbines & motor generators
- Main Inlet Valves
- Hydromechanical Gates
- Mechanical BOP
- Electrical BOP
- Control System with cybersecurity

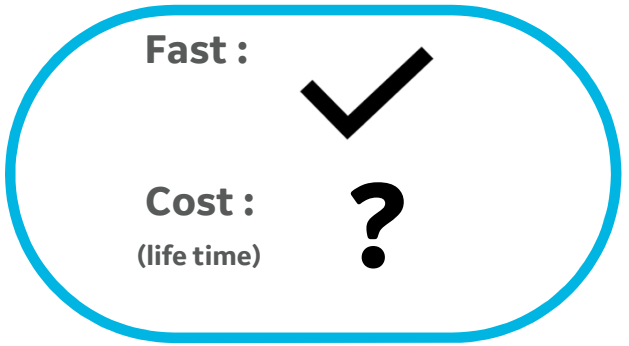
Optimisation du Contrôle







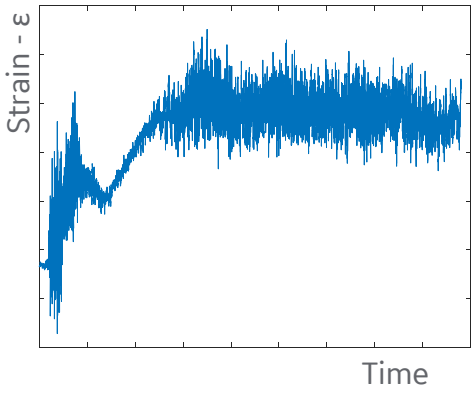
- Wider GV opening for faster Speed Ramp Up (SRU)
- Robust control strategy for faster coupling at Speed No Load (SNL)



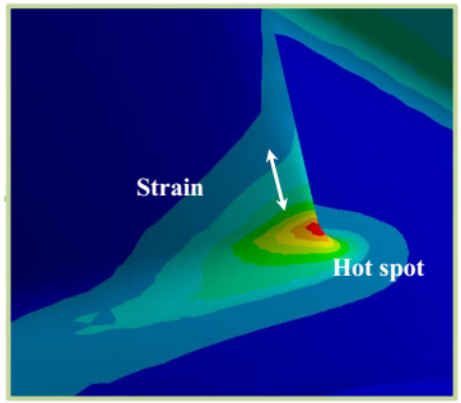
Mésurer l'endommagement de roues protos

Full Scale Method

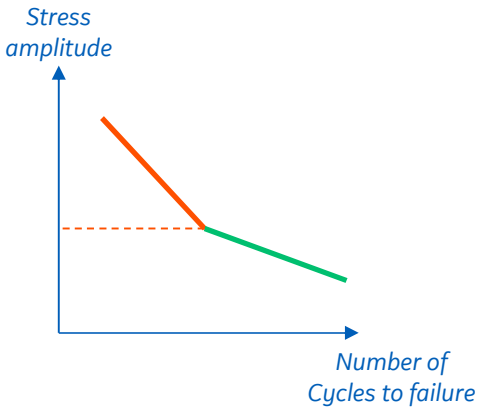
On site strain measurement



FEA Calculation



Rain-Flow + material fatigue curve



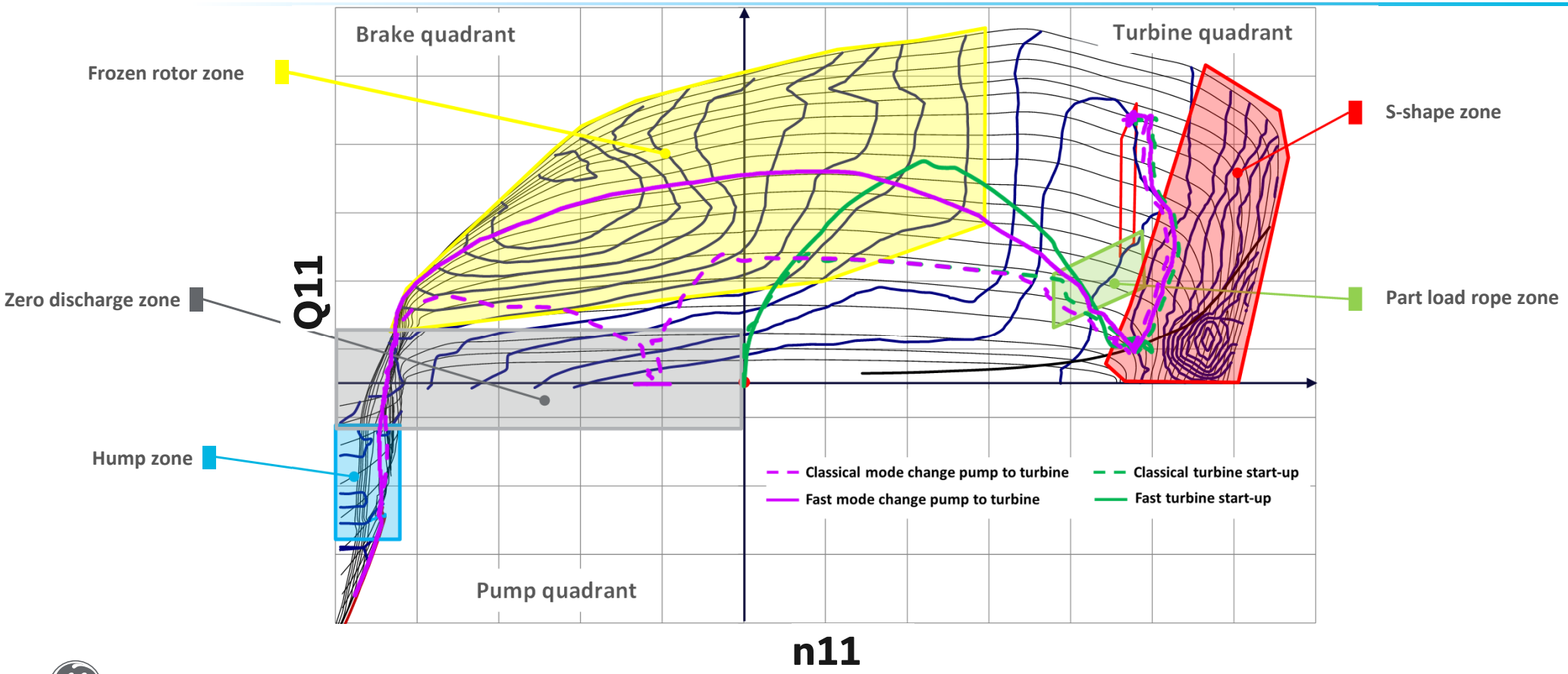
Unit lifetime consumption

Reliable method, but not suitable for offline optimization of sequences

Colline d'endommagement

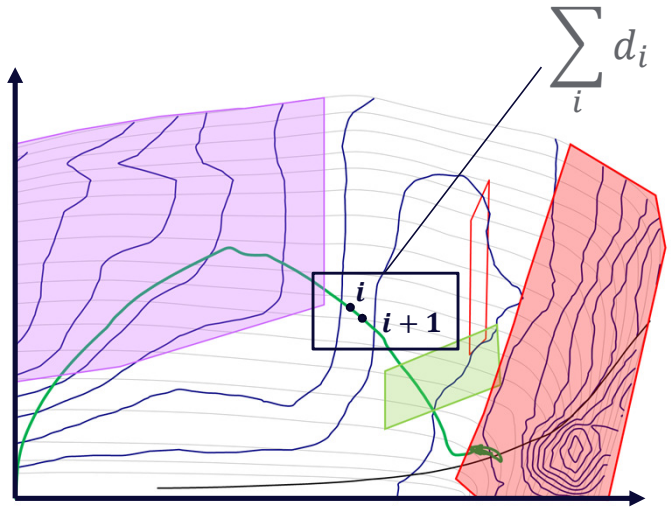
Reduced scale Method

Mapping of the hydraulic phenomena

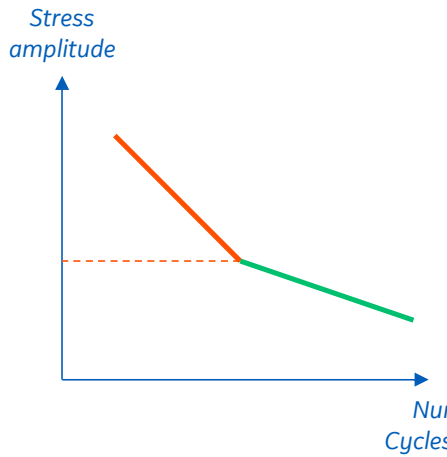


Analyse des trajectoires

Reduced scale Method



material fatigue curve



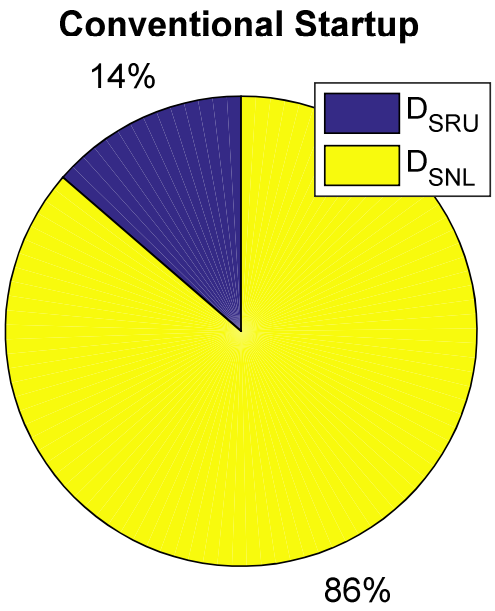
Unit lifetime consumption

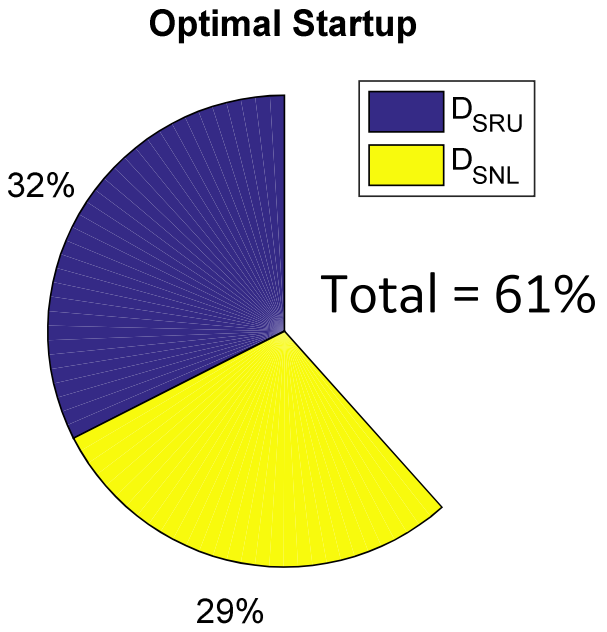
Fully offline method, suitable for optimization

Cas d'étude : démarrage

Conventional Vs Optimal

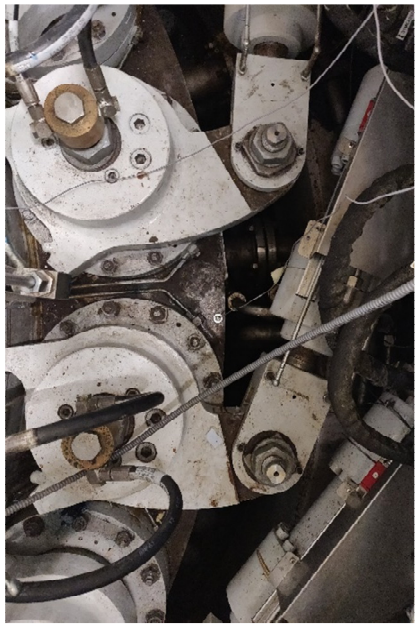
- Conventional startup: 86 % of damage due to time spent at SNL for coupling
- Optimal startup: Time and damage at SNL divided by three



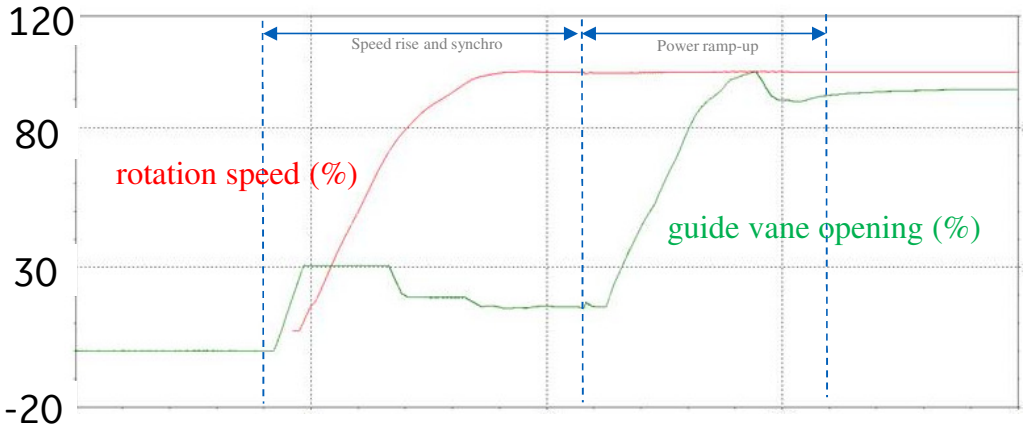


Overall runner damage and startup time are reduced

Gilboa : Validation sur la machine (taille réelle)



Optimized start-up of Gilboa in generation mode with conventional distributor control algorithm.

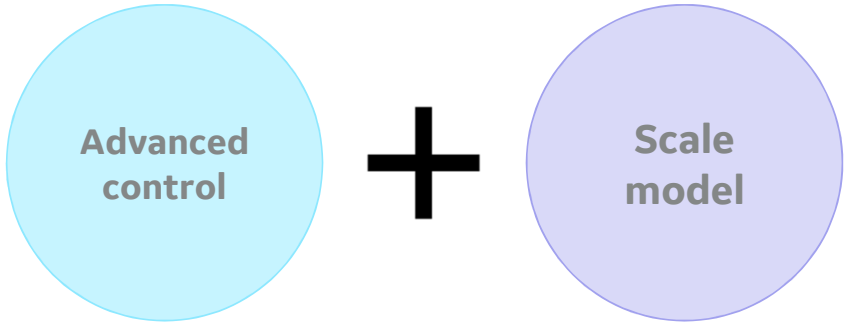


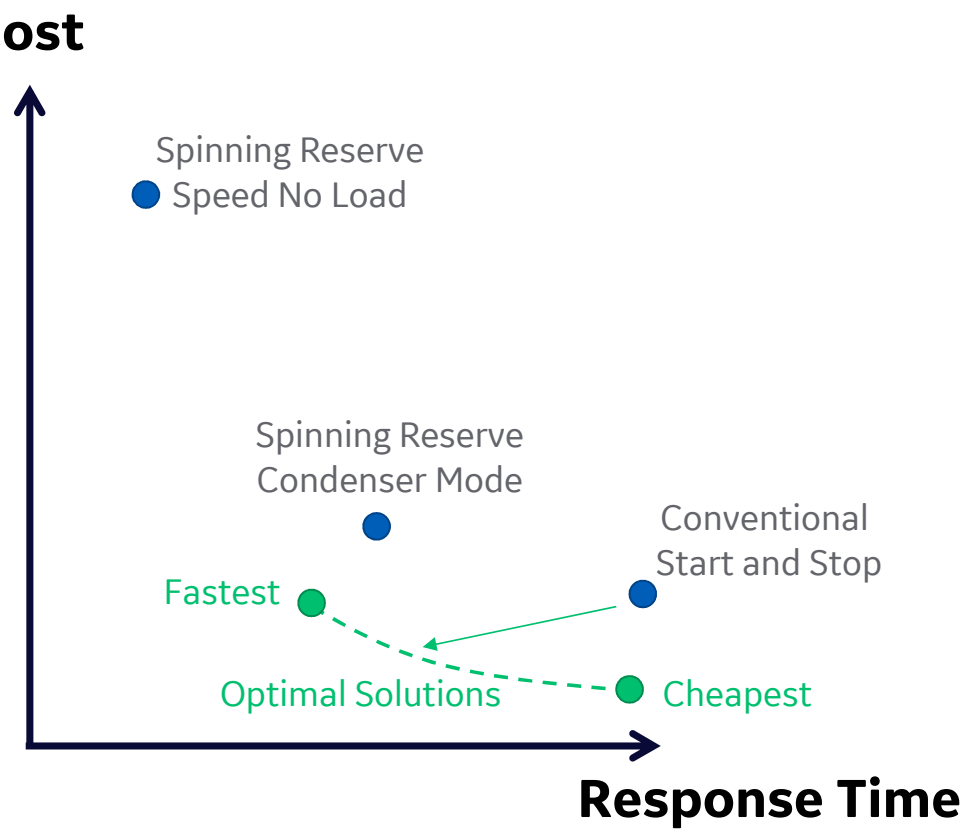
Gilboa's normal startup takes approximately 90 seconds to go from **0 to 100% power** while a fast startup takes only **70 seconds or less**

Conclusion 1 : Méthodologie

Operation at SNL is highly damaging

GE Solutions





Conclusion 2 : à plus grande échelle

- Une application ‘extrême’ a apporté de nouvelles fonctionnalités aux STEP (turbines francis reversibles)

- Ces fonctionnalités, qui peuvent accompagner un ‘découplage’ avec le nucléaire & un couplage avec les autres EnR, sont désormais disponibles