



AVEVAWORLD
PARIS

OCTOBER 2024

Improving operational efficiency with an innovative approach to data utilization

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World's leading producer of net-zero electricity

90% carbon-free electricity generation

Europe's leading hydroelectric producer

A global leader in wind and solar

Europe's top investor in energy transition

with € 16,4 bn of investment

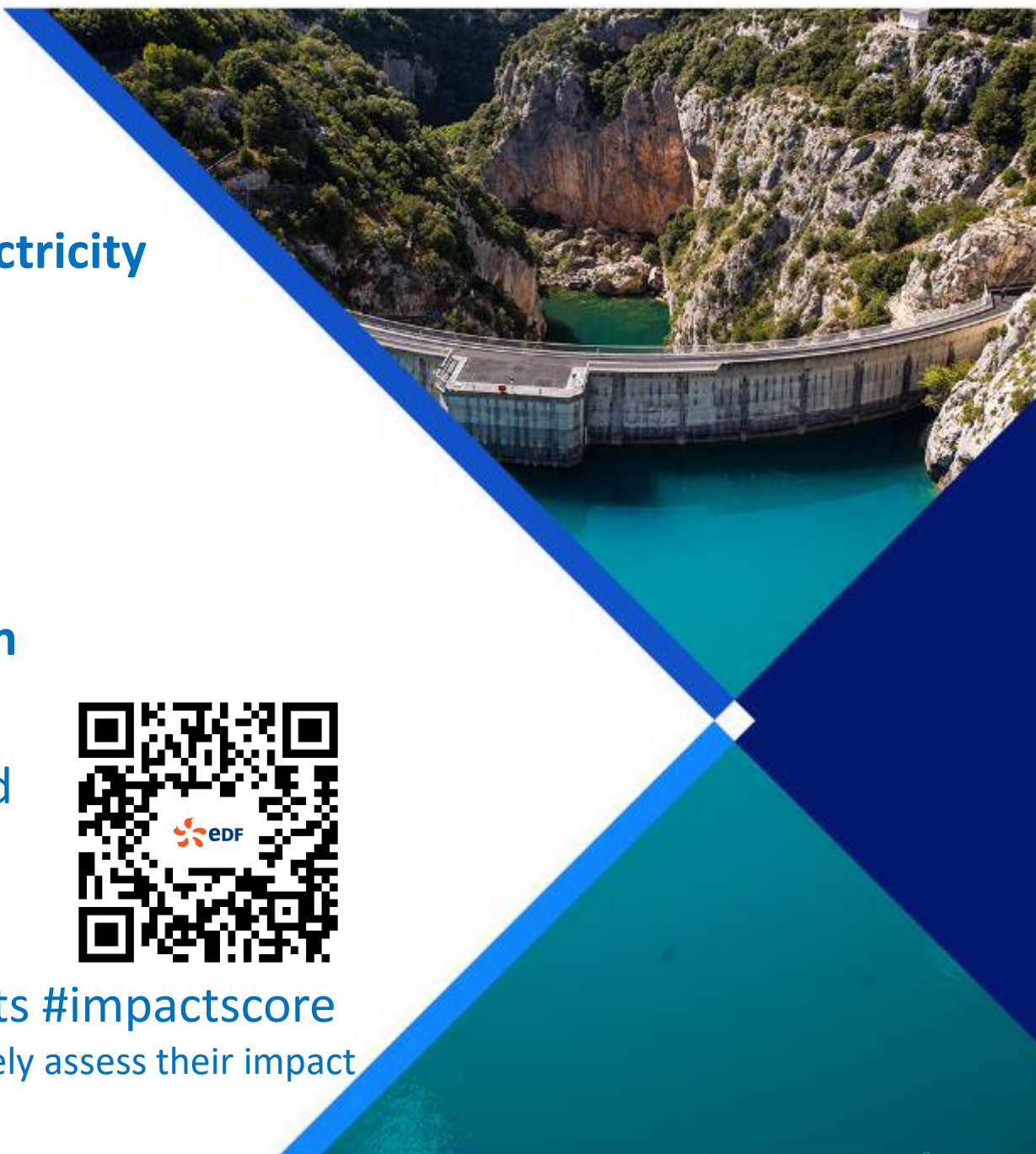
Almost 180,000 collaborators in the world

with 75% located in France

Recruitment in progress of 20,000 more

First major French company to calculate its #impactscore

a framework that enables businesses to comprehensively assess their impact





OUR PURPOSE

To build a net zero energy future through electricity and innovative solutions and services, contributing to environmental sustainability, well-being and economic growth.

EDF Hydro Division in video



Who in the audience has ever asked themselves one of these questions ?

How to :

- Minimize the time spent to deploy AF template instances and enable users to do it ?
- Automatically generate AF hierarchies from the company's asset repositories ?
- Extend AVEVA PI System features ?

Answering these questions was our challenge

Inventory of use cases

- Back in 2020, the Hydro monitoring and performance communities were considering the creation of more than 80 AF templates
- We classified the expected AF templates in 3 categories using 3 criteria :

	Algorithm complexity +	Input Parameters (Number and complexity to find the static values)	Number of expected instances
Light	Simple	Few or no	Any
Medium	Simple to moderately complex	Few to many	> 25% of the fleet
Heavy	Moderately complex to complex	Many	> 50% of the fleet

Non exhaustive list of expected AF templates

Light	Medium	Heavy
Averages	Calculation of startup and shutdown sequences of generation unit in all operating modes	Power plant and generation unit efficiency calculation + link to a Digital Twin
Totals	Linear regression	Head losses monitoring
Gradients	Duration to a state since a date	Linear interpolation (1 & 2 dimensions) using abacuses
Polynomial calculation	Sensor monitoring	Estimated date of the next Pelton Wheel inspection
Apparent power	Generation unit braking time	Alternator refrigerant fouling indicator
Number of occurrences	Asset operating time	Time counter after coupling a unit to the electrical grid
Distance traveled by a moving asset	Monitoring of reservoir elevation constraints	Threshold exceedance (several thresholds, Hysteresis...)
Edge counter	Duval Triangle (transformers)	email and SMS notifications
Deviation from the flowrate specifications	Asset maneuvering time	Counting of intermittency cycles
...
50 %	25%	25%

We estimated the distribution of the 80 planned templates based on the categories

Deploying instances of an AF template

Is it suitable to use AVEVA tools (PI System Explorer and PI Builder) to scale up ?

- We decided to test the manual deployment process, on a medium complexity AF Template :
 - Calculation of the startup sequence of hydro generation units in generator mode (over 700 for that template)
- It took nearly 60 days to deploy the instances for just 30% of the fleet, involving hundreds of emails and Excel files
- By extrapolating, it could take more than 160 days to deploy the AF template on the whole fleet

		Progress	
		30%	100%
PI Team	Development & testing on Ancillary	9	9
	Deployment on ancillary & production	25	83
Monitoring Community	Development & testing on Ancillary	5	5
	Deployment on ancillary & production	20	67
		59	164

- We took a break to ask ourselves the right question : **Is this manual method viable in the long term ?**

Deploying instances of an AF template


- We estimated the workload for each team (PI & Hydro Communities) based on the categories :
 - for the manual process
 - for a potential automated process

All numbers are in Days

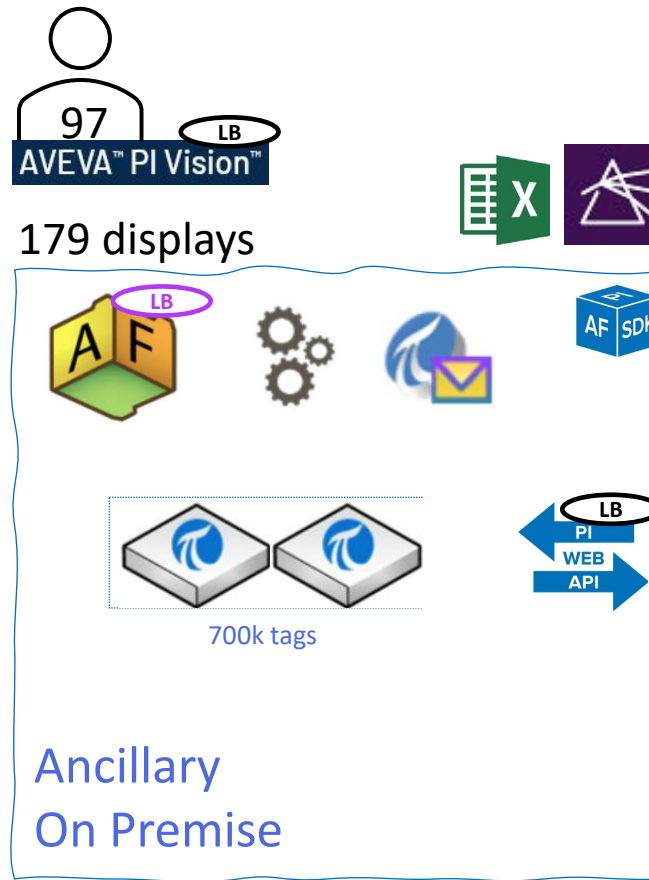
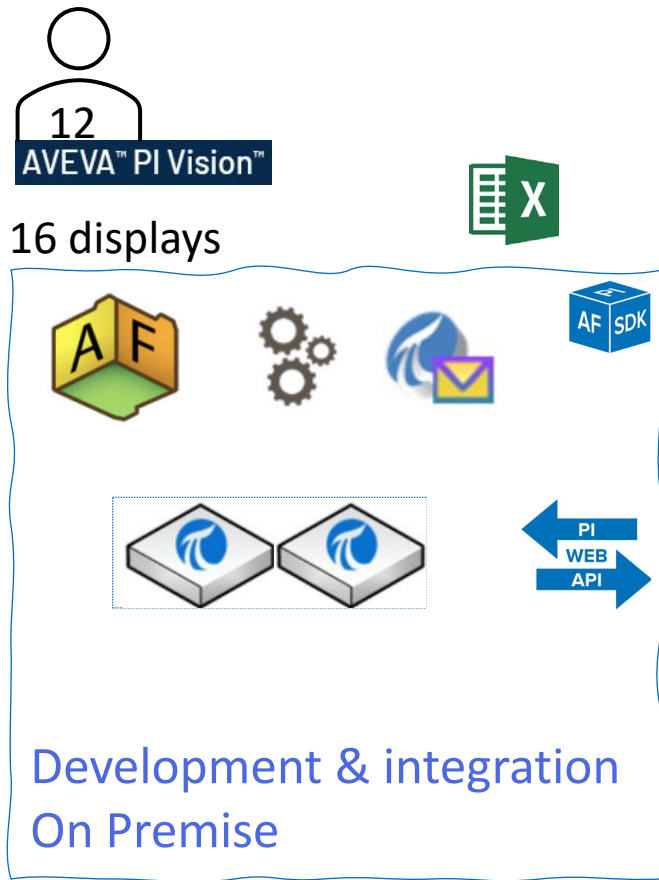
		Expected if done manually			-80%	Expected if automated		
		Light	Medium	Heavy		Light	Medium	Heavy
		40	20	20		40	20	20
Number of templates		2	6	12		2	6	12
PI Team	Development & testing on Ancillary	25	83	100		1	1	3
	Deployment on ancillary & production	1080	1787	2240		120	140	300
	Totals for the team	5107			-4547	560		
		3	5	20		3	5	20
Monitoring Community	Development & testing on Ancillary	20	67	80		3	10	20
	Deployment on ancillary & production	920	1433	2000		240	300	800
	Totals for the team	4353			-3013	1340		

A potential 80% reduction in the time required to deploy models

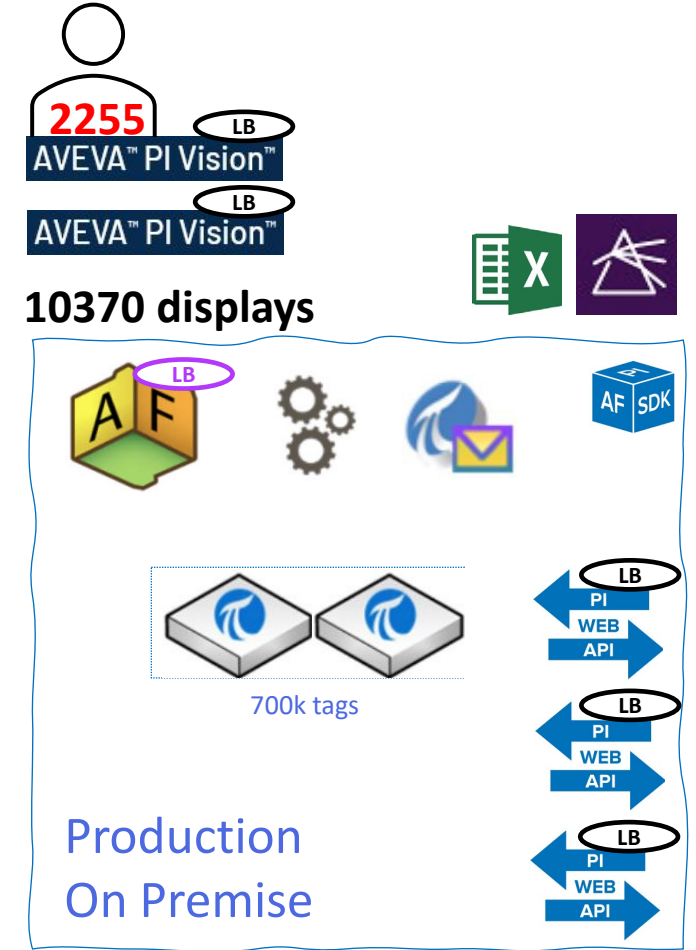
- This experience convinced us that the time saved could finance the development of a tool around the PI System to help us meet our goals

- Project name : 

AVEVA Stack at EDF Hydro



220 daily connected users (average)



LB : Actual instances behind a load balancer
LB : Forecasted instances behind a load balancer

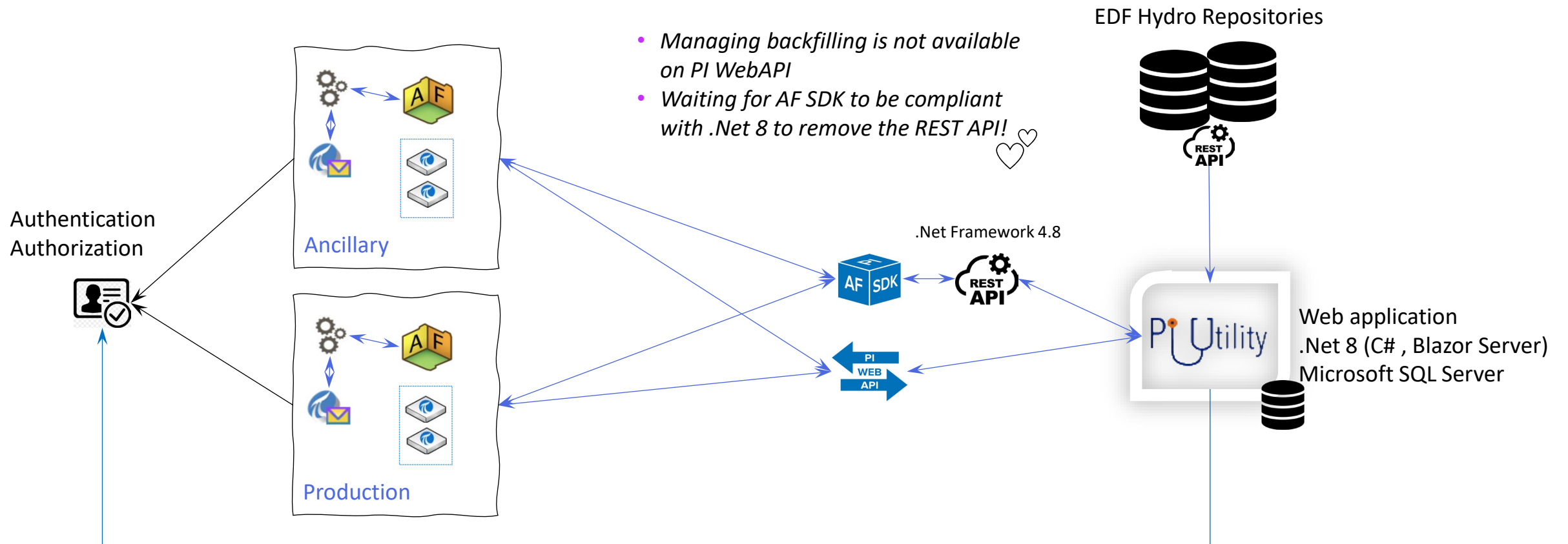
N : Number of users who connected at least once

QUESTION 1

How to minimize the time spent to deploy AF template instances and enable users to do it ?

Technical solution

Using the existing AVEVA stack and EDF Hydro systems



AF Template Creation and Deployment process

- To enhance clarity and storytelling, let me introduce you to :

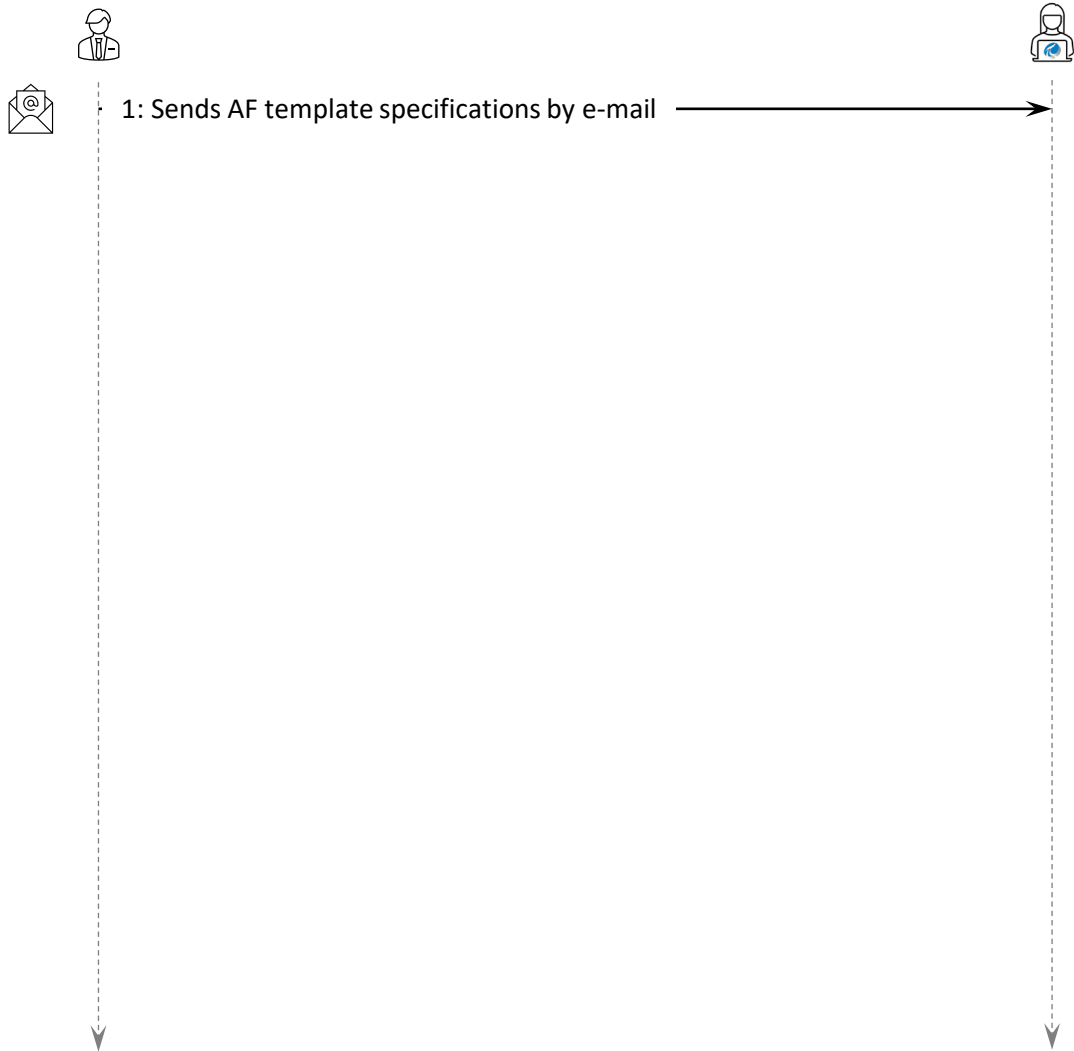


Estelle : Member of the PI System team



Michael : Member of the Hydro monitoring & performance communities

AF Template Creation and Deployment process



Michael sends Estelle a formatted e-mail outlining his requirements.

This need has already been shared and discussed within the monitoring or production communities.

Description À quoi sert le modèle ?	
Domaine d'application À choisir dans la liste suivante (ou proposer un nouveau domaine si la liste existante est incomplète) : Alternateur, Calculette, Conduite forcée, Groupe, Jumeau numérique, Notifications, Hydraulicité, Production, Retenue, Services systèmes, Vanne	
Utilisateurs du modèle Qui utilisera le modèle ?	
Généricité Indiquer si le modèle traite d'un cas d'usage très spécifique ou s'il peut être déployé sur le parc EDF hydro	
Délai de réalisation souhaité	

AF Template Creation and Deployment process



1: Sends AF template specifications by e-mail

2: Creates the AF Template on PI Ancillary



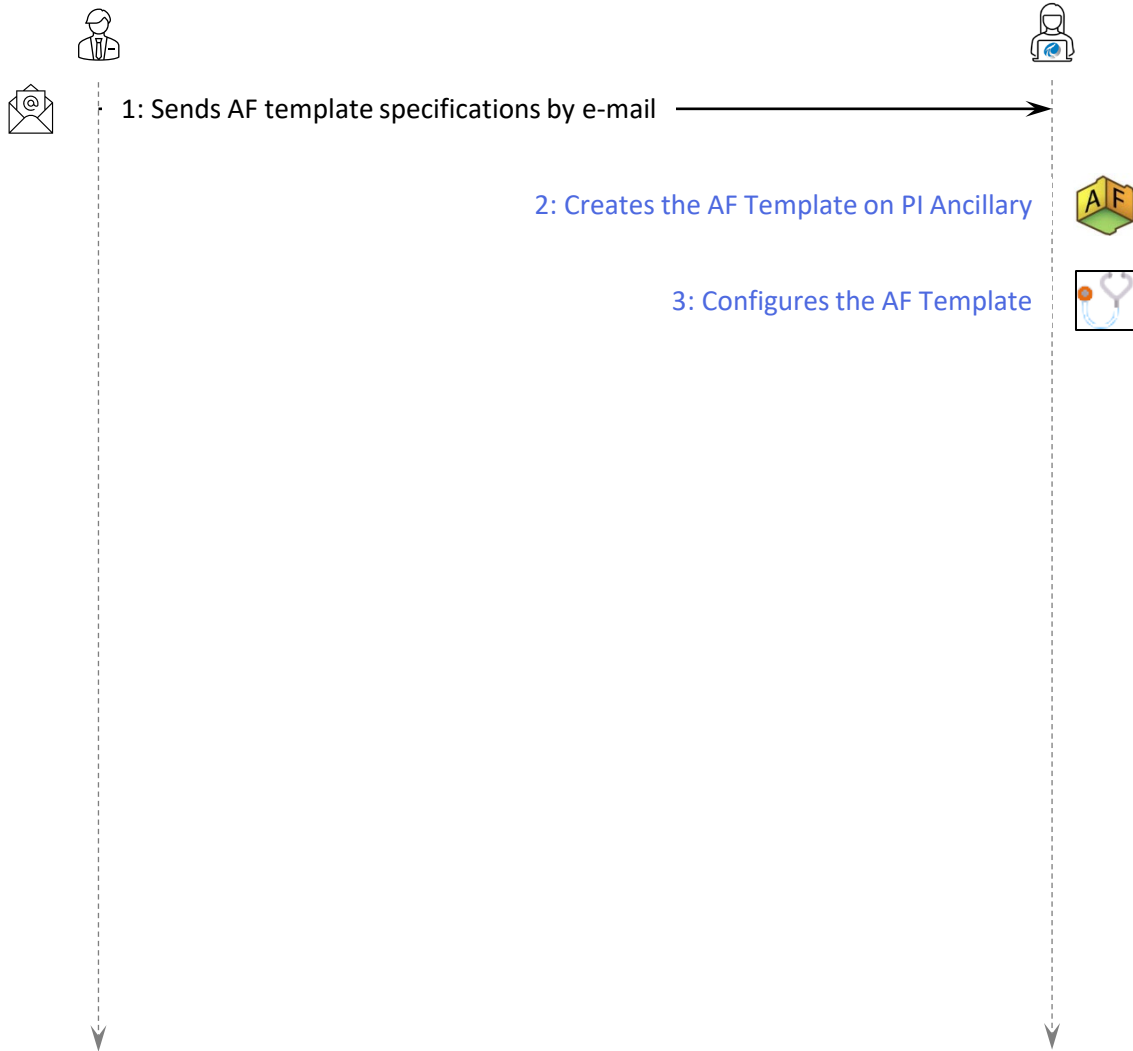
Estelle :

- **Selects a model code**
- **Identifies the type of Hydro asset associated with the template (generation unit, transformer, penstock, valve...)**
- **Creates the AF template on the Ancillary system**
- **Prepares the documentation**
- **Develops a PI Vision display to assist Michael in testing the template**
- **Conducts the unit testing**

Filter	Name	Description	Default Value
Category: Configuration Sable Facultative			
	Accord pour Calcul EPS	Autorisation de calcul...	1
	Coef NCE Bar	Coefficient de transfert...	10.1900 mCE/bar
	Coef Modulation Saisonale	Coefficient de modulation...	1.00
	Commentaires	Commentaire global...	
	Critere Stabilité EPS	Ecart maximum tolérab...	1.50 mCE
	Le diamètre de conduct...		0
	Grandeurs DSFC et JN compatibles	Les FNChg du jumeau...	
	Groupes alimentés par la CF	Groupes alimentés par...	
	Remarques	Localisation de plaqu...	
	Seuil EPS moyen aberrant	Seuil au delà duquel le c...	15 mCE
	Seuil Pa Arrêt Adduc	Seuil de puissance en...	2.000 MW
	Seuil Pa Arrêt Groupe	Seuil de puissance en...	1.000 MW
	Seuil Stab Pa Addition	Seuil de stabilité sur la...	8 %
	Seuil Stab Press EPS	Critère à orle maximal...	0.18 bar
	Seuil Stab Press PDC	Critère à orle maximal...	0.00 bar
	Seuil Tm Stab Press PDC	Critère à orle maximal...	0.15 bar
	Typ Correction PDC par EPS Moy	Choix de la correction (...)	
Category: Configuration Sable Obligatoire			
	Altitude Capteur DSFC	Altitude du capteur de...	-999.00 mNSG
	Cote Amont Max	Côte amont maximum	-999.00 mNSG
	Cote Amont Min	Côte amont minimum	-999.00 mNSG
	Diamètre CF DSFC	Diamètre de la condut...	999.000 m
	EPS Moyen par Defaut	Correction par défaut...	-999.00 mCE
	Hb Max	Chute brute maximum	-999.00 mCE
	Libellé Tag Cote Amont	Libellé du tag Cote Am...	à saisir
	Nb Jours pour Moyenne EPS	Nombre de jours utilis...	999 jour
	Puiss Groupe	Puissance max groupe...	-999.00 MW
	Press Max	Pression statique Max...	-999.00 bar
	Press Groupe	Débit max groupe (seu...	-999.00 m3/s
	CoefNATEPSF	Préfixe CoefNATEPSF	0
Category: Tag Entité			
	Cote Amont My10M	Côte amont de la cham...	0.00 mNSG
	Defr Amont My10M	Defr groupe amont...	0.000 m3/s
	Pa Addition	Puissance active de gr...	0.000 MW
	Pa Addition Ec30M	Ecart 30M de Puissanc...	0.000 MW
	Pression Capteur Ec10M	Pression du capteur DC...	0.00 bar
	Pression Capteur My10M	Pression du capteur DC...	0.00 bar
	Puissance active groupe	Puissance active de gr...	0.000 MW

Name	Expression	Output Attribute
Horodatage	'**-\$4gs'	Map
NumMois	Month(Horodatage)	Map
CoefNCEBarCorrigeSaison	'Coef NCE Bar' + (((-0.000027502*Pow(NumMois,3)) + (0.00040837*Pow(NumMois,2)) - (0.0009176*NumMois))	Map
ArretAdduction	if BadVal(TagVal('Pa Addition','Horodatage)) then False else (Abs(TagVal('Pa Addition','Horodatage')) < 'Seuil Pa Arrêt Adduc')	Map
GroupeService	if BadVal(TagVal('Puissance active groupe','Horodatage')) then False else (Abs(TagVal('Puissance active groupe','Horodatage')) > 'Seuil Pa Arrêt Groupe')	Map
tabPaAdducRange30M	InterpolateValues('Pa Addition Ec30M','-'9m','-'30m')	Map
PaAdducRange30M	LastValue(tabPaAdducRange30M)	Map
PaAdducRange30MDataValid	ArrayLength(FilterData(tabPaAdducRange30M,NOT BadVal(\$val))) = ArrayLength(tabPaAdducRange30M)	Map
PaAdduction	'Pa Addition'	Map
RatioStabPaAdduc	if not BadVal(PaAdduction) AND not BadVal(PaAdducRange30M) then if (PaAdduction <= 0) then ((PaAdducRange30M / PaAdduction)*100) else 100	Map
PaAdducStable	RatioStabPaAdduc < 'Seuil Stab Pa Addition'	Map
VfValid	not BadVal(TagVal('Vf fermee','Horodatage')) OR (DigText('Vf fermee') = 'No Data')	Map
PasDePVdf	(VfValid AND (TagVal('Vf fermee','Horodatage') = 0))	Map
PasDePchoLaDeRetenue	if ((not BadVal(TagVal('Tag Inhibition si Valeur a 0','Horodatage')) AND (TagVal('Tag Inhibition si Val OR (not BadVal(TagVal('Tag Inhibition si Valeur a 1','Horodatage')) AND (TagVal('Tag Inhibition si Vale	Map
	False	Map
	True	Map
CoteMoy30M	'Cote Amont My10M'	Map
CoteChoisie	if not BadVal(CoteMoy30M) AND CoteMoy30M > 'Cote Amont Min' AND (CoteMoy30M < 'Cote Amont Max')	Map
PressionMoy30M	'Pression Capteur My10M'	Map

AF Template Creation and Deployment process



Estelle configures the AF Template in PI Utility.

Généralités PeChgDSPCF - Pertes de charge DSPCF

Code (unique) : PeChgDSPCF **Libellé :** Pertes de charge DSPCF

Description :
Calcule les pertes de charge DSPCF

Liste des équipements déployables :
EGF-G - Groupe

Catégorie : Conduite forcée **Uri de la page d'aide :** https://si-confluence.edf.fr/display/dshypsystemhy/PeChgDSPCF

> Configuration Serveur/Environnement
> Déploiement & Templates/Modèles
▼ Configuration du back-filling

Aide
 Désactiver le backfilling

Date la plus ancienne autorisée : 01/01/2016
Valeur par défaut : 01/01/2018

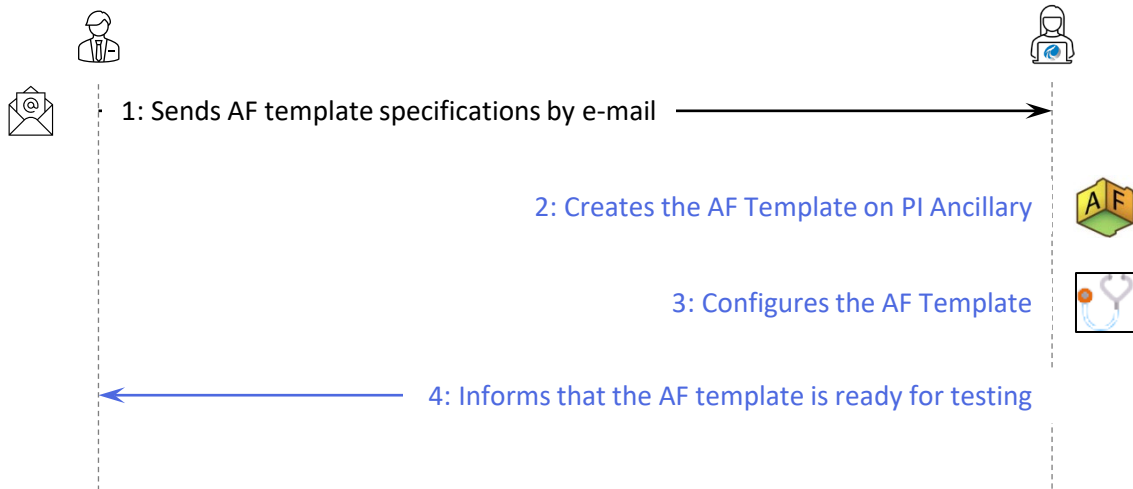
Date de recalcul par défaut : 01/01/2023
Valeur par défaut : 01/01/2020

Découpage en nombre de jours : 366
Valeur par défaut : 366

Priorité (plus haute, plus grand) : 50
Valeur par défaut : 50

Convertisseur de demandes en actions : Default

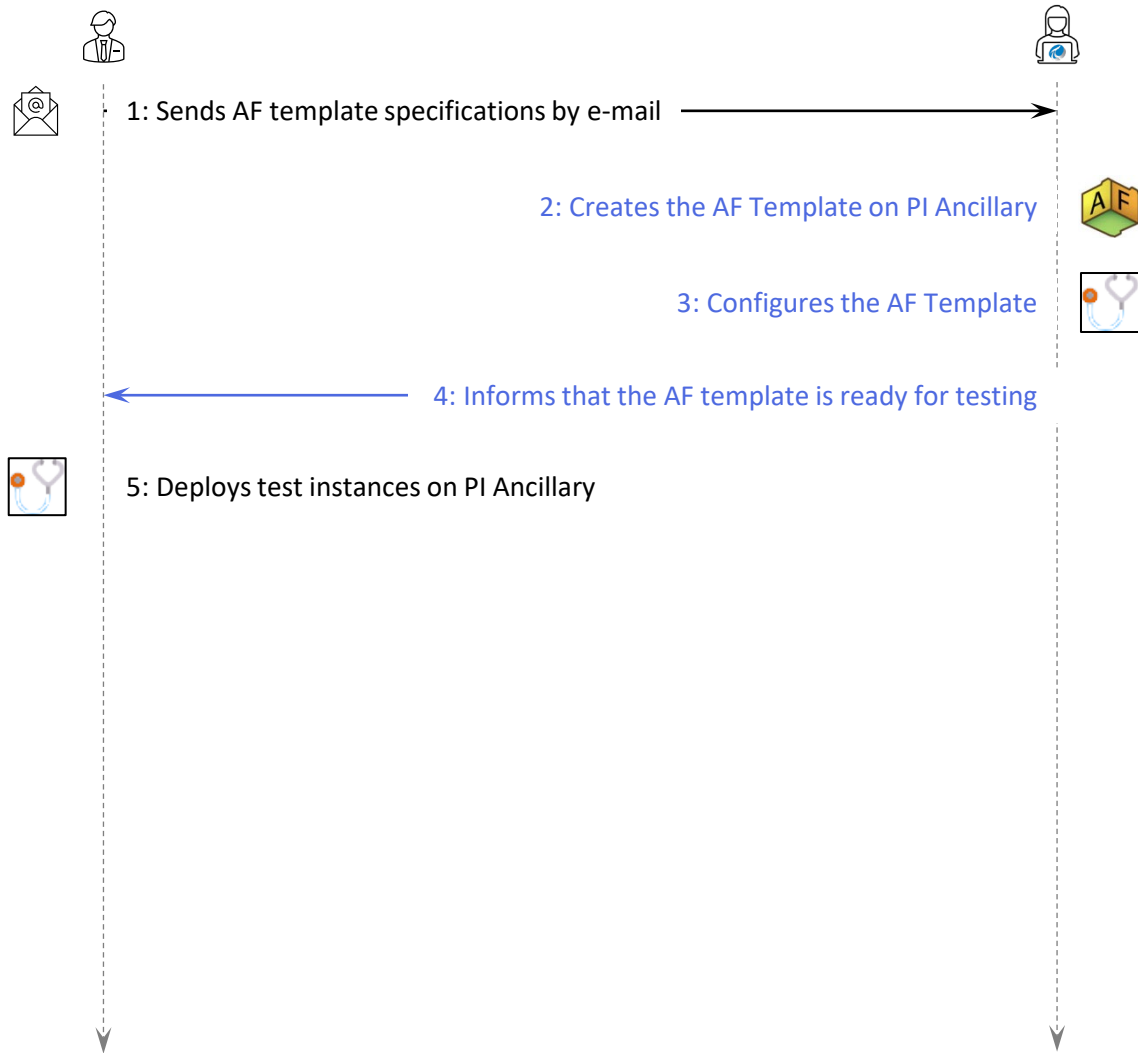
AF Template Creation and Deployment process



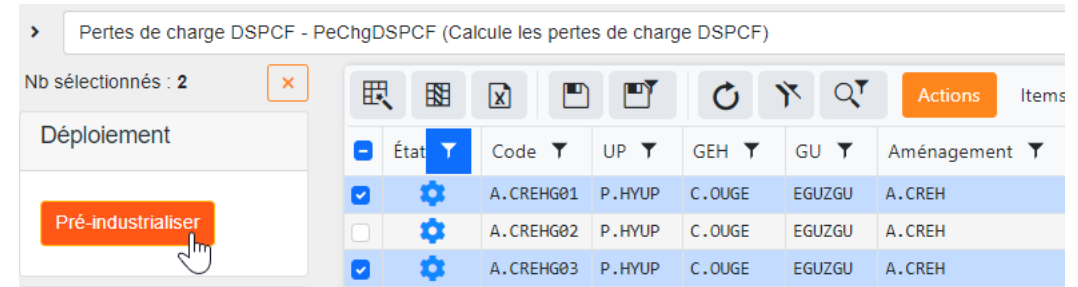
Estelle informs Michael that the AF template is available in PI Utility.

Catégorie	Modèle	Code	Attributs inco...	Attributs valides	Pré-industrialisé	Industrialisé	E...	Non déployable
▼ Catégorie: Conduite forcée								
Conduite forcée	ⓘ Pertes de charge DSPCF	PeChgDSPCF				297		
▼ Catégorie: Jumeau numérique								
Jumeau numérique	ⓘ Ecart perte de charge mesuré-calculé	EcPeChg				236		14

AF Template Creation and Deployment process



Michael selects the AF Template in PI Utility and chooses the assets to test it.



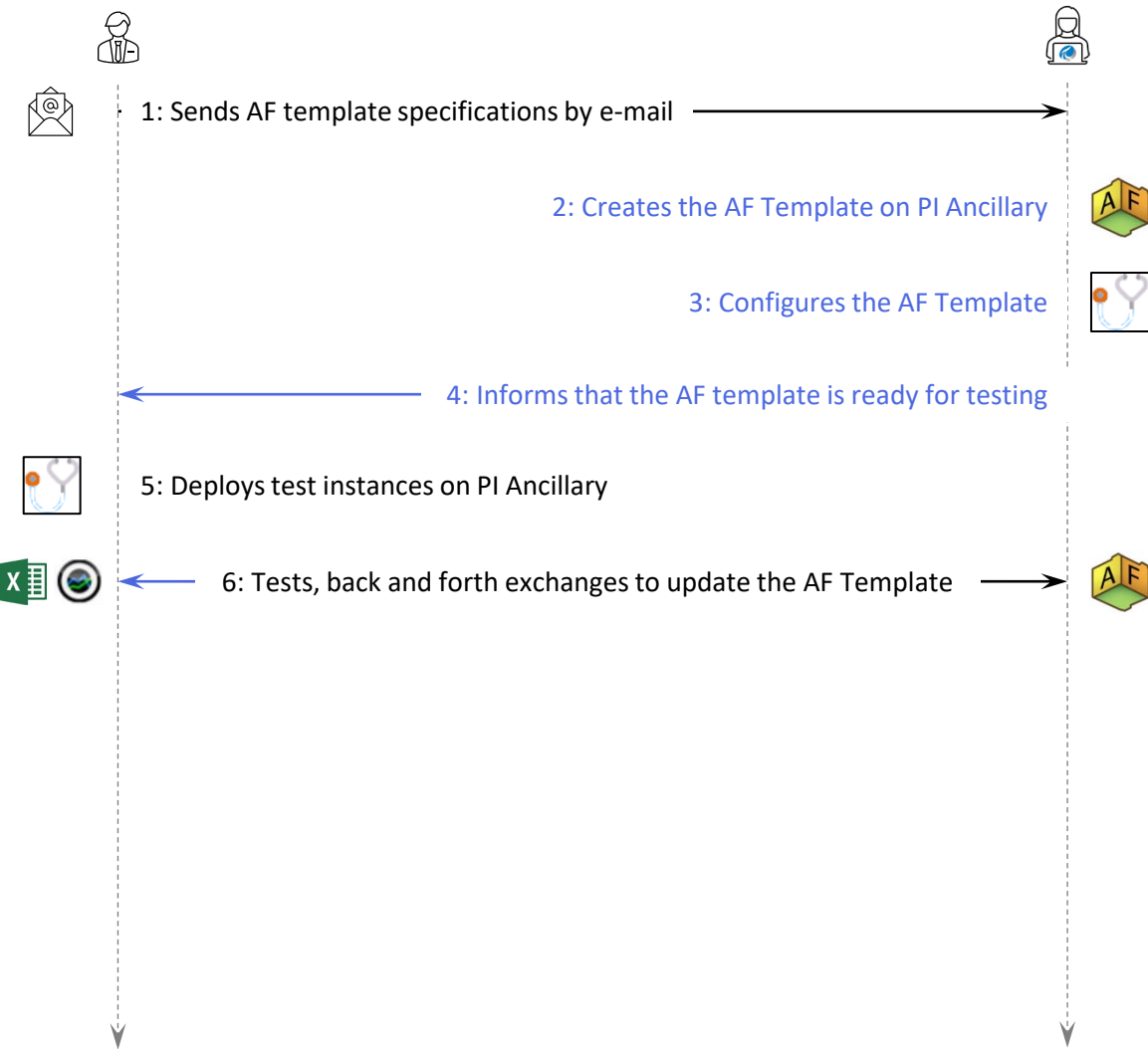
For each selected asset, PI Utility performs the following actions **on the ancillary PI System** :

- Creates the AF Template instance
- Maps the input attributes to PI tags (using naming pattern)
- Creates the output tags
- Starts the analysis
- Initiates the backfilling if configured for the template

État	Code	UP	GEH	GU	Aménagement	Recalcul	Action	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	A.CREHG01	P.HYUP	C.OUGE	EGUZGU	A.CREH	<input checked="" type="checkbox"/> 01/01/2023	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	A.CREHG02	P.HYUP	C.OUGE	EGUZGU	A.CREH		
<input type="checkbox"/>	<input checked="" type="checkbox"/>	A.CREHG03	P.HYUP	C.OUGE	EGUZGU	A.CREH	<input checked="" type="checkbox"/> 01/01/2023	

The single chevron indicates that the instance is deployed on the ancillary PI System only

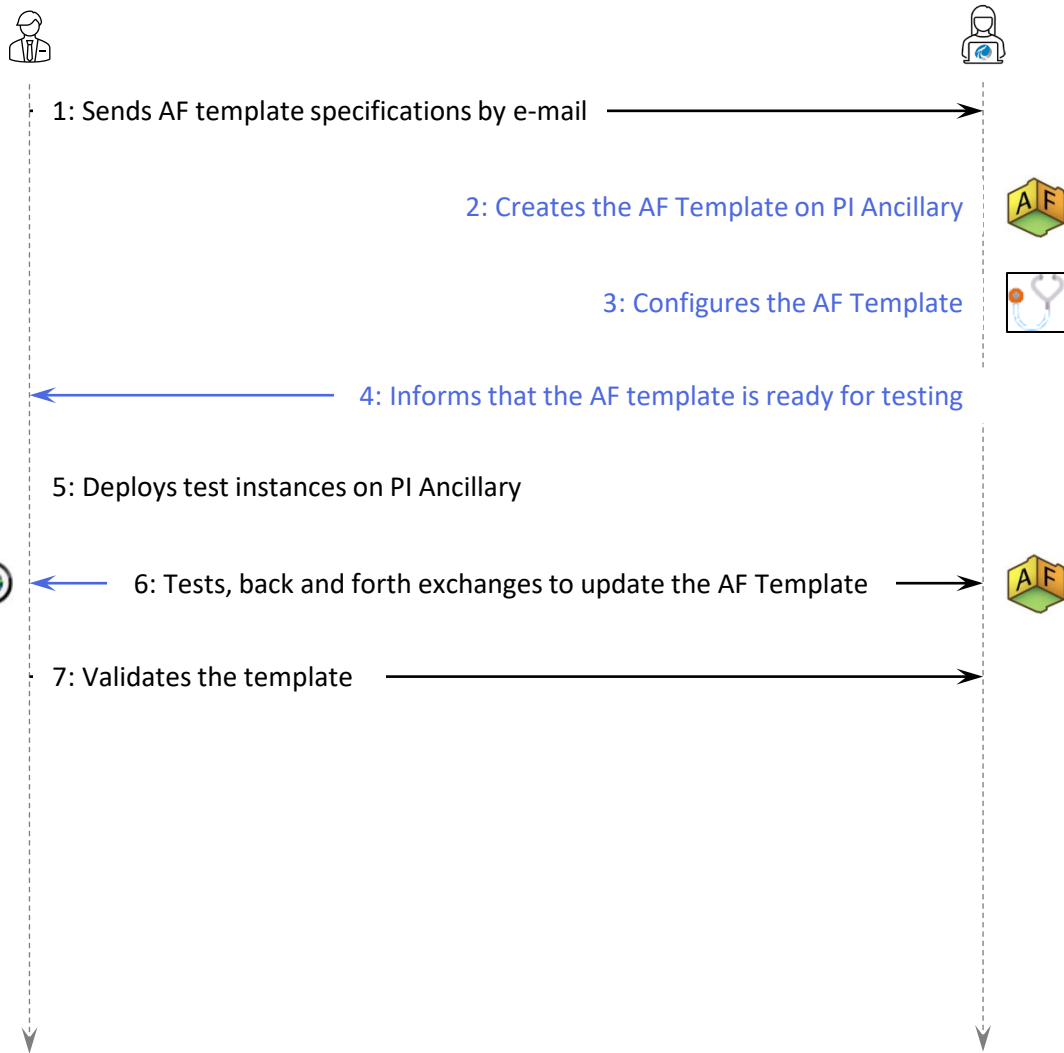
AF Template Creation and Deployment process



Michael uses PI Vision and PI Datalink to test the AF template.

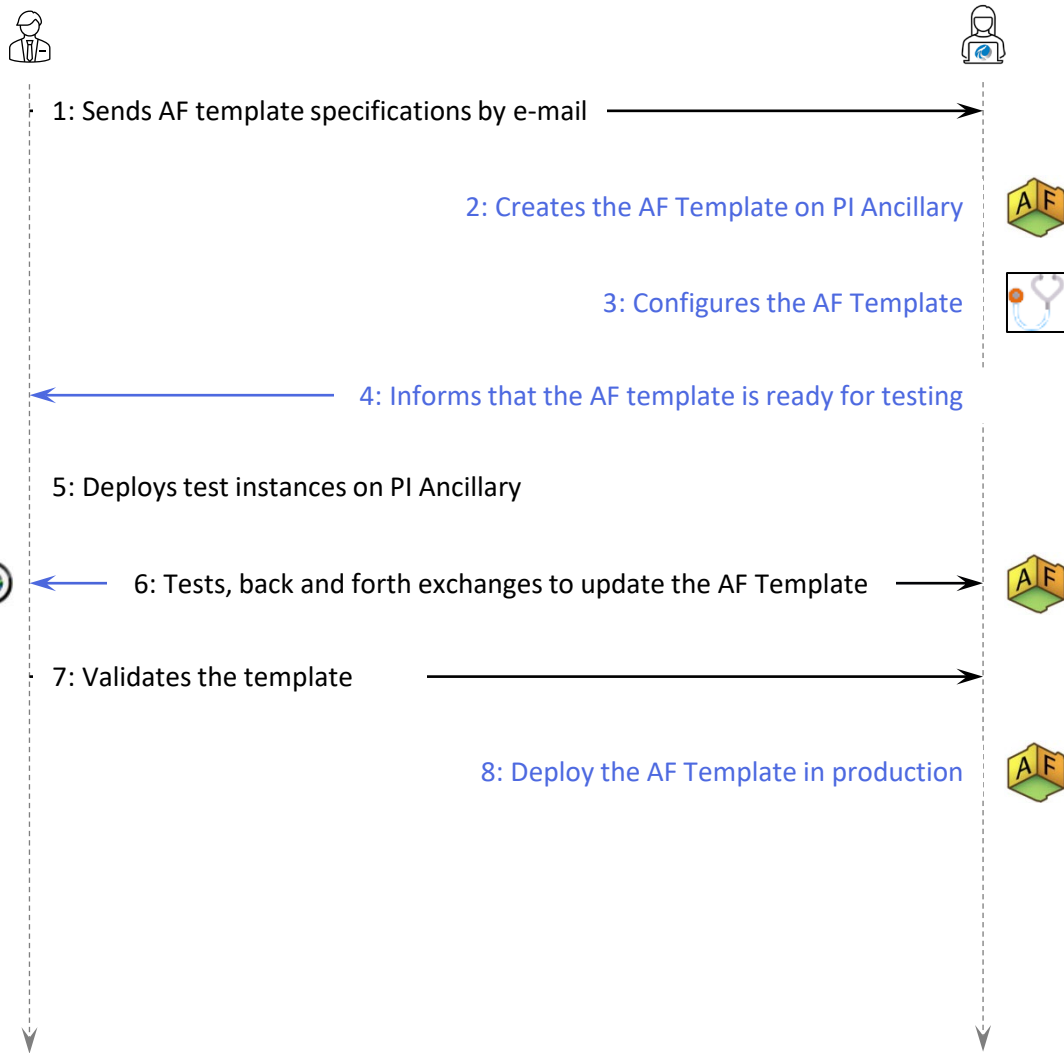
If necessary, Estelle updates the template and Michael continues testing.

AF Template Creation and Deployment process



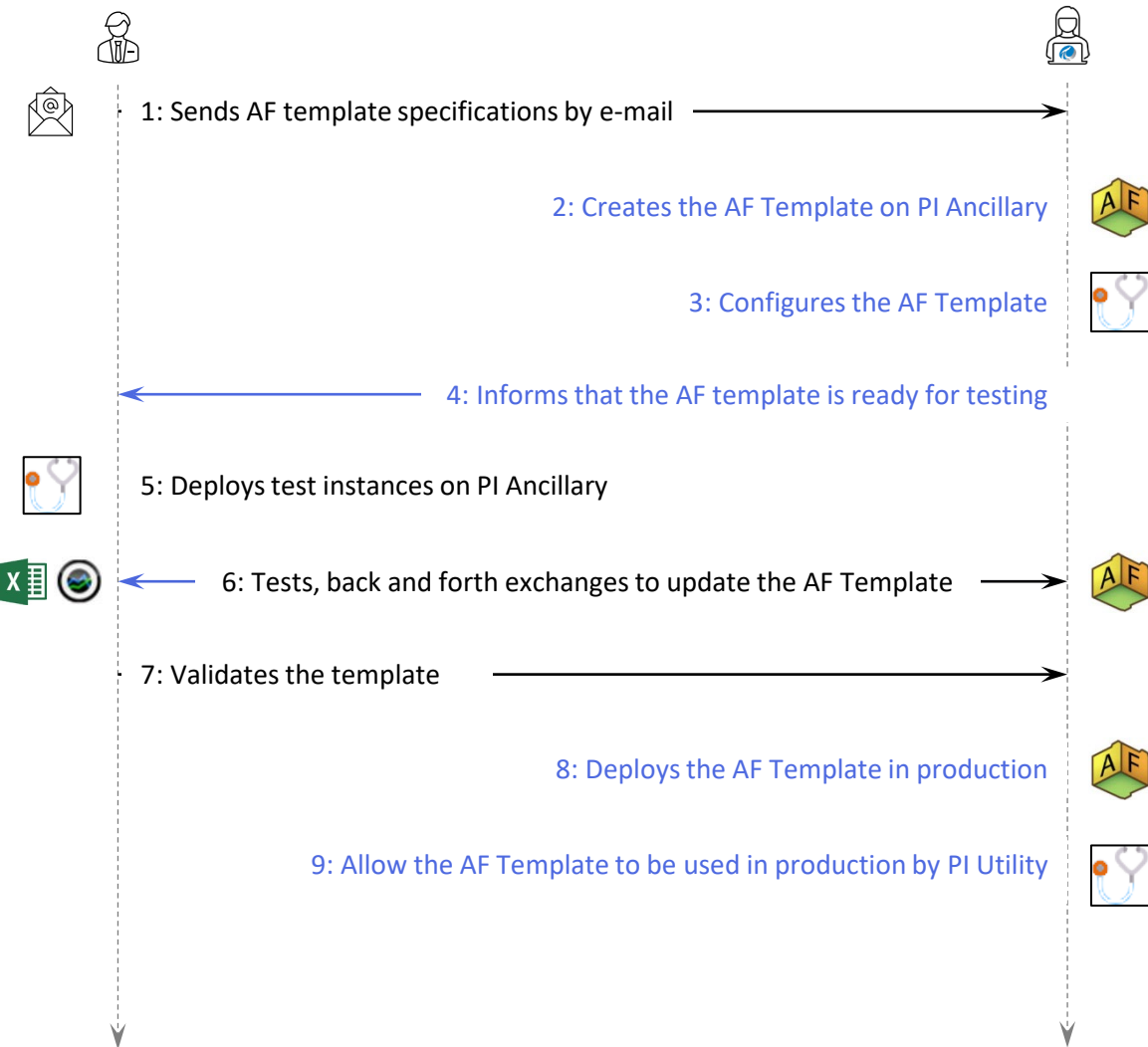
Michael informs Estelle that he validates the AF template.

AF Template Creation and Deployment process



Estelle deploys the AF template to the production environment.

AF Template Creation and Deployment process



Estelle allows in PI Utility the AF template to be used in production.

▼ Généralités PeChgDSPCF - Pertes de charge DSPCF

Code (unique) : PeChgDSPCF Libellé : Pertes de charge DSPCF

Description :
Calcule les pertes de charge DSPCF

Liste des équipements déployables :
EGF-G - Groupe

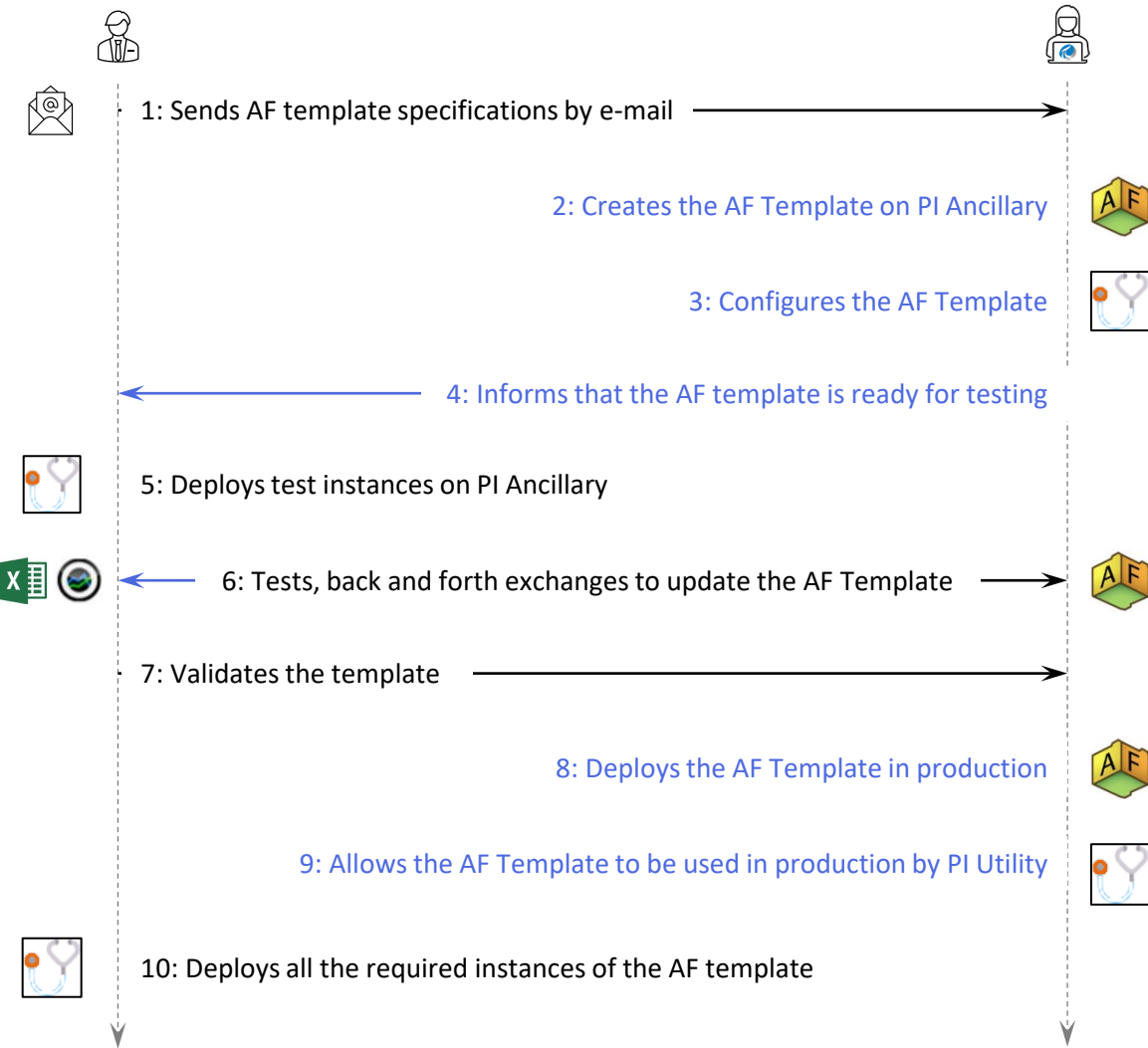
Catégorie : Conduite forcée Url de la page d'aide : <https://si-confluence.edf.fr/display/dshypisystemhy/PeChgDSPCF>

Weak référence :
Aucun

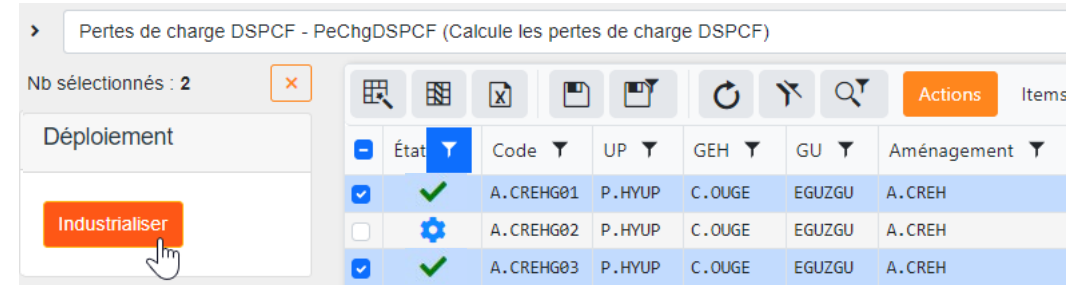
Visible uniquement pour les administrateurs

Autoriser l'industrialisation du modèle

AF Template Creation and Deployment process



Michael deploys the instances of the AF template to production.



For each selected asset, PI Utility carries out the following actions in the **PI Production system**:

- Creates the AF Template instance
- **Copies the attributes configuration** from the ancillary instance
- Generates the output tags
- Starts the analysis
- Initiates the backfilling if configured

État	Code	UP	GEH	GU	Aménagement	Recalcul	Action
✓✓	A.CREHG01	P.HYUP	C.OUGE	EGUZGU	A.CREH	✓ 01/01/2023	👁️ 📄
⚙️	A.CREHG02	P.HYUP	C.OUGE	EGUZGU	A.CREH		
✓✓	A.CREHG03	P.HYUP	C.OUGE	EGUZGU	A.CREH	✓ 01/01/2023	👁️ 📄

The double chevron indicates that the instance is deployed on both the ancillary AND production systems with the same settings

Dashboard that allows to monitor all the deployed instances and their statuses



Incomplete settings

Deployed on ancillary only

Deployed on ancillary AND production

Assets excluded from the template

Items/page : 200

Rechercher...

Catégorie	Modèle	Code	Attributs inco...	Attributs valides	Pré-industrialisé	Industrialisé	E...	Non déployable
Calculette	Translation et écrêtement	TrIEcr	3		2	3		
▼ Catégorie: Conduite forcée								
Conduite forcée	Pertes de charge DSPCF	PeChgDSPCF				297		
► Catégorie: Création de tags								
▼ Catégorie: Durée								
Durée	Durée à un état depuis une date	DurEtat	1		4	20		
Durée	Temps de freinage	TpFr	3		30			
Durée	Temps de fonctionnement	TpsFct			1	1102		29
Durée	Temps de fonctionnements avec conditions paramétrables	TpsFct Condition	33	2	13	1		
Durée	Temps de fonctionnement entre 2 conditions sur donnée	TpsFct2Cdi	2		71	207		10
Durée	Déprécié - Temps de fonctionnement entre 2 TOR (ne plus	TpsFct2Tor	8	1	31	151		10
▼ Catégorie: Ecart								
Ecart	Ecart 10 Min	Ec10Mn	1			299		4
Ecart	Ecart entre deux valeurs	Ec2Val			1	7		
Ecart	Ecart 30 Min	Ec30Mn	4			296		2
▼ Catégorie: Gradient								
Gradient	Gradient évènementiel conditionné	GdEvtCd	1		59	34		2
Gradient	Gradient périodique conditionné	GdPrdCd	2			17		2
Gradient	Gradient périodique sur valeurs moyennées	GdPrdValMy	1		6	31		
▼ Catégorie: Groupe								
Groupe	Estimation de la prochaine visite de roue (POC)	EstViRo	23		16			
Groupe	Estimation de la prochaine visite de roue	EstViRoTeqPmax				9		
Groupe	Intensité de phase	IPh			5			
Groupe	Puissance groupe indispo	PaGpldp				31		
Groupe	Puissance apparente	Pap				525		15
Groupe	Séquence d'arrêt en compensateur synchrone	SqArtCp	2		11	49	1	270
Groupe	Séquence d'arrêt en pompe	SqArtPp				34		1
Groupe	Séquence d'arrêt en turbine	SqArtTb	42	30	31	483		175

Afficher les éléments 1 - 159 de 159

Instances in error

Deviation from the flowrate specifications

- **Classification**

- Light

- **Objectives**

- Calculation of the power produced by a plant when the downstream flow exceeds the specifications related to the concession.

- **Time to build and test**

- 2 days

- **Time to deploy**

- 2 days (40 power plants)

- **Earnings**

- Several hours saved per power plant
- Quality and precision of the results



Année	Moyenne	Pourcentage Ecart	Qmax CDC (%)	Maximum Pourcentage Ecart	Qmax CDC (%)	Total Energie en Dépassement (MWh)	Total Energie Aménagement (MWh)
01/01/2015 - 01/01/2016							
01/01/2016 - 01/01/2017							
01/01/2017 - 01/01/2018							
01/01/2018 - 01/01/2019	13,7			16,3		2216	25984
01/01/2019 - 01/01/2020	13,7			20,0		2467	44981
01/01/2020 - 01/01/2021	14,3			20,0		4758	79181
01/01/2021 - 01/01/2022	12,4			15,2		2021	55800
01/01/2022 - 01/01/2023	10,3			14,3		919	27955
01/01/2023 - 01/01/2024	13,4			18,3		2133	64371

Monitoring of reservoir elevation constraints

- *Classification*

- **Medium**

- *Objectives*

- Definition of up to 7 elevation constraints (Contextual levels, low water level, tourist levels, drinking water...)
- Overlay of the reservoir level over the last ten years

- *Time to build and test*

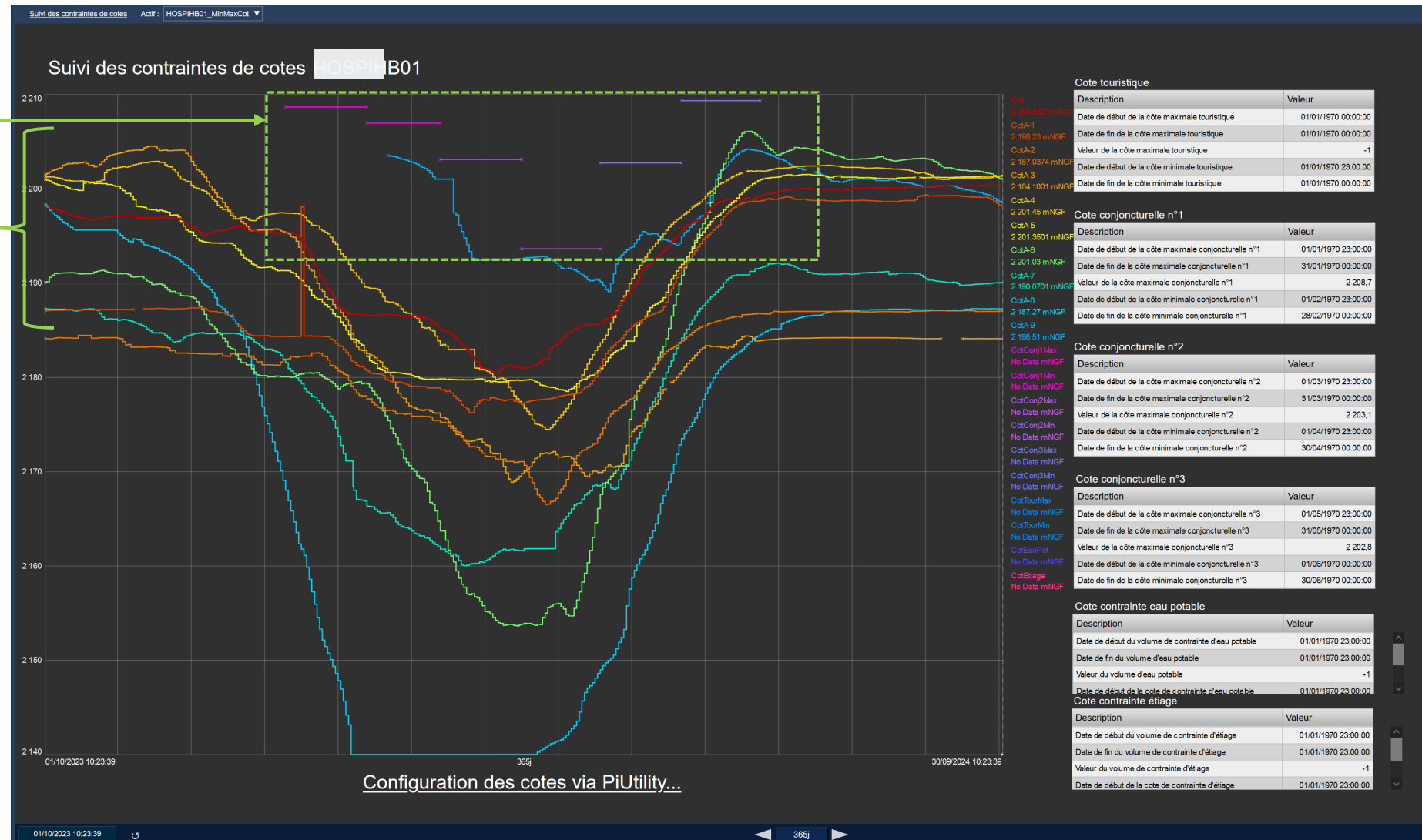
- 4 days

- *Time to deploy*

- 5 days (100 reservoirs)

- *Earnings*

- Instant visualization of reservoir history
- Real-time monitoring of compliance with the reservoir level constraints



Estimated date of the next Pelton wheel inspection

- **Classification**

- **Heavy**

- **Objectives**

- Automatic calculation of the next Pelton wheel inspection, considering the history, the operation of the wheel and its load, and the EDF Hydro reference document on wheel monitoring
- Uses the past 3 years history to forecast 3 possible dates
- Will be done on ~300 wheels at the target

- **Time to build and test**

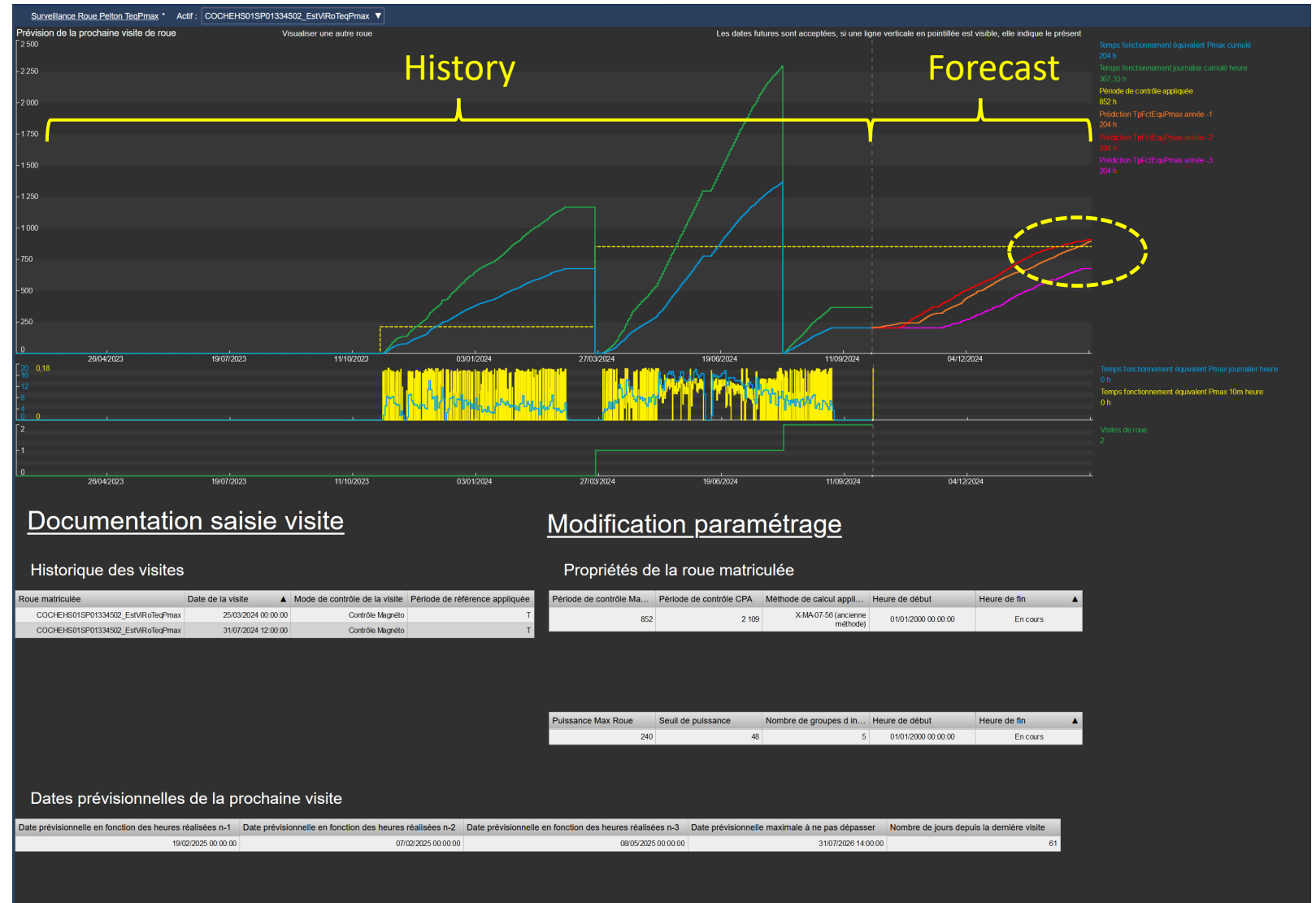
- 13 days on AF + 30 on PI Utility

- **Time to deploy**

- Deployment in progress
- 20-30 days (at the target)

- **Earnings**

- Assistance in scheduling the wheel inspection at the most appropriate time (economically and according to production constraints)
- Days of work per wheel



Head losses monitoring

- *Classification*

- **Heavy**

- *Objectives*

- Comparison of measured head losses with those calculated by the digital twin

- *Time to build and test*

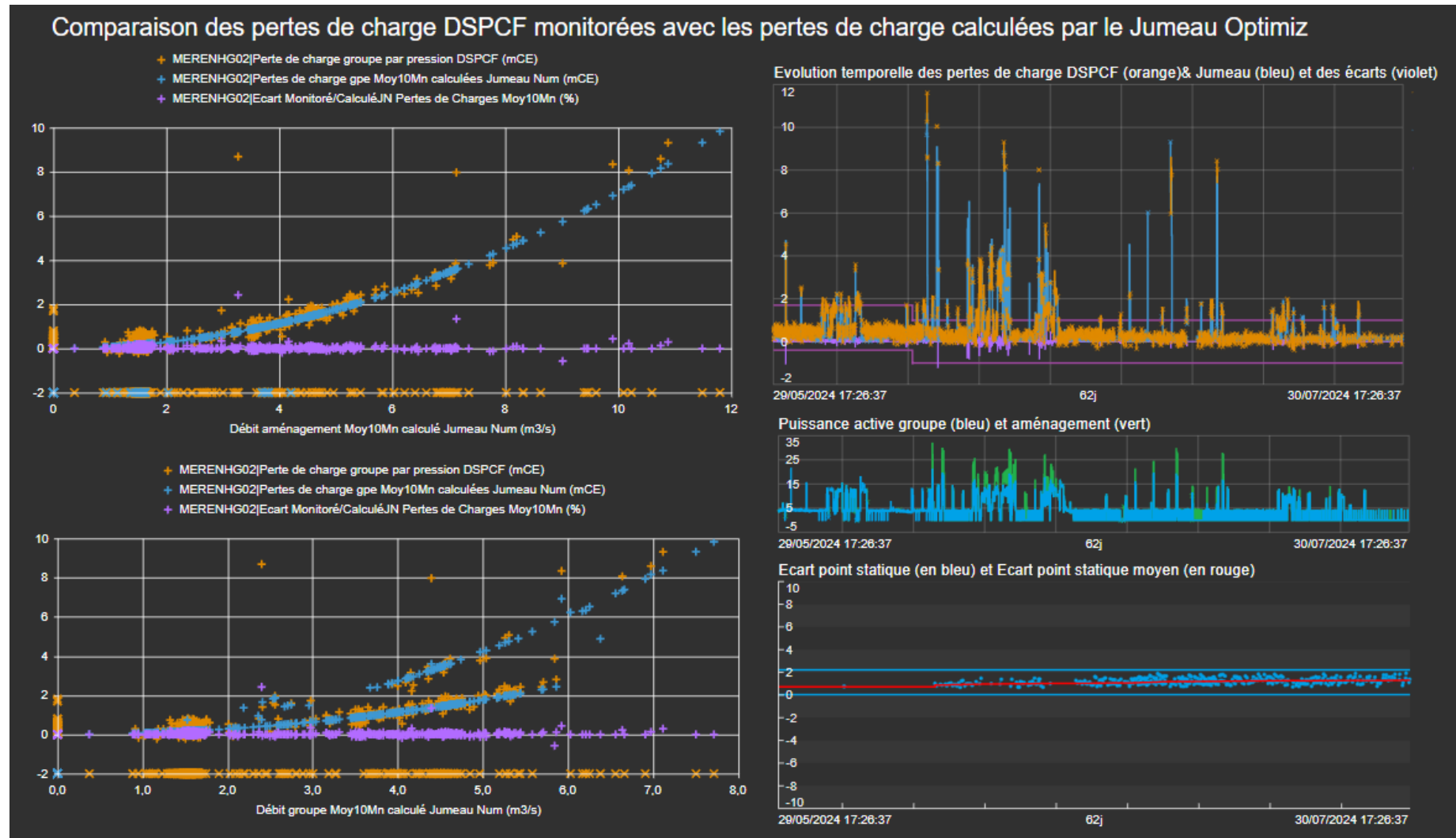
- 6 days

- *Time to deploy*

- 50 days (297 generation units)
 - Mainly spent searching for the exact values of the model's static attributes

- *Earnings*

- Knowing the head losses of all the galleries, penstocks and the net heads
 - Improving the quality of the energy models of our installations in the digital twin that are used for the calculation of the Hydro power plant's programs
 - Detecting abnormal head losses and problems in turbines



Example of comparison between monitored data and data calculated by the digital twin

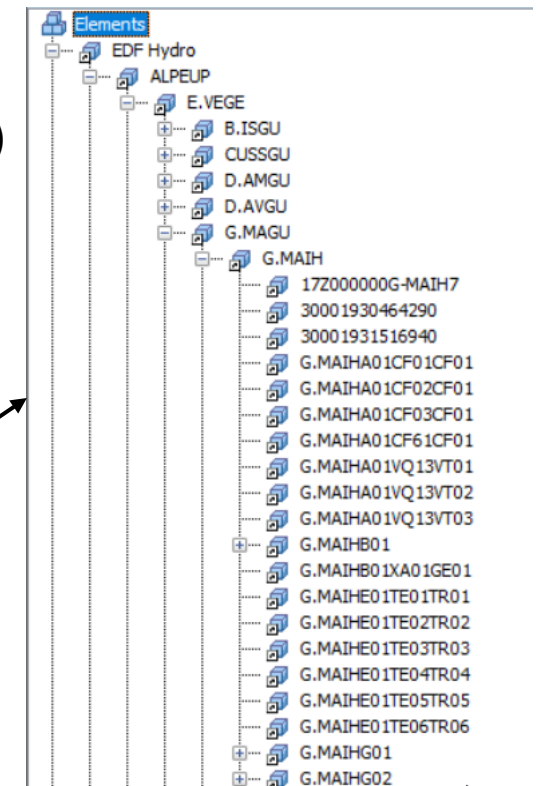
QUESTION 2

How to automatically generate AF hierarchies from the company's asset repositories ?

Automatically generate AF hierarchies from the company's asset repositories

- Deploying **AF elements to represent assets** is technically like deploying **AF elements to perform calculations**, so the same mechanism could be applied
- We just had to create
 - One **AF template per asset type** (generation unit, dam, transformer, penstock, valve...)
 - One **AF template per organization entity** (Production Unit, Group of power plant, power plant)
- Configure these templates in PI Utility

Catégorie	Modèle	Code	Pré-industrialisé	Industrialisé
▼ Catégorie: Arbre Métier				
Arbre Métier	Arbre METIERS AMEN	MetiersAMEN		440
Arbre Métier	Arbre METIERS Barrages	MetiersBarrage		446
Arbre Métier	Arbre METIERS Bypass	MetiersByPass		
Arbre Métier	Arbre METIERS Centrale Hydraulique	MetiersCentraleHydraulique	1	477
Arbre Métier	Arbre METIERS Compteurs	MetiersCompteur		905
Arbre Métier	Arbre METIERS Conduite Forcée	MetiersConduiteForcée		723
Arbre Métier	Arbre METIERS Déchargeur Barrage	MetiersDechargeurBarrage	68	
Arbre Métier	Arbre METIERS Déchargeur Groupe	MetiersDechargeurGroupe	23	
Arbre Métier	Arbre METIERS Dégriilleurs	MetiersDegriilleur		33
Arbre Métier	Arbre METIERS Ecluses	MetiersEcluse		20
Arbre Métier	Arbre METIERS Exhaure	MetiersExhaure		366
Arbre Métier	Arbre METIERS GEH	MetiersGEH		17
Arbre Métier	Arbre METIERS Groupes	MetiersGroupe		1195
Arbre Métier	Arbre METIERS Groupes Electrogenes	MetiersGroupeElectrogene		33
Arbre Métier	Arbre METIERS GU	MetiersGU		84



Automatically generate AF hierarchies from the company's asset repositories

- Create a mechanism to map AF attributes to PI tags using naming patterns and exceptions

The screenshot displays the Pi Utility software interface (version 3.3.5.0) with a navigation bar at the top containing 'Référentiels', 'Tags', and 'Administration'. The main area is divided into two sections. The upper section shows a table of AF attributes with columns for name, description, type, and data archive. The lower section shows a table of PI tags with columns for name, value, and tag name. A red dashed box highlights 'Puissance réactive groupe' in both tables. A green dashed box highlights the naming pattern '{ECSH}AL{ECSH:7;0}mQr' in the top table and '\\DPIH-Historian\AIGLEHG01AL01mQr;UOM=MVAR' in the bottom table. A black arrow points from the pattern in the top table to the tag in the bottom table.

+						
			Puissance active groupe	Puissance active groupe - Groupe	Groupe	DataArchive
			Puissance réactive groupe	Puissance réactive groupe - Groupe	Groupe	DataArchive
StringBuilder						Ordre
			{ECSH}AL{ECSH:7;0}mQr			1
			{ECSH}AL{ECSH:7;0}mQ			2
1						
			Puissance active groupe (Mesure ...	Puissance active groupe (Mesure télé...	Groupe	DataArchive
			Etat groupe	Etat groupe - Groupe	Groupe	DataArchive

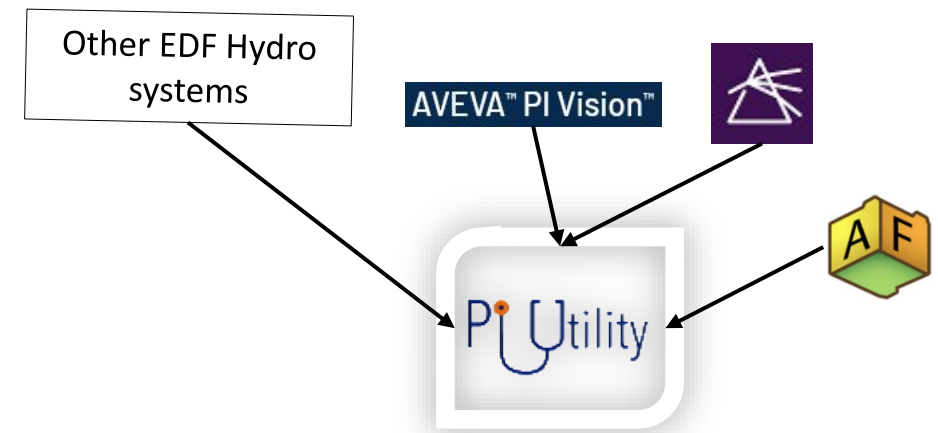
			Puissance maximale groupe en pompe	Excluded	
			Puissance maximale groupe en turbine	Excluded	
			Puissance réactive groupe	0,000 MVAR	\\DPIH-Historian\AIGLEHG01AL01mQr;UOM=MVAR
			Rendement groupe en Hn Moy10Mn calculé Jumeau Num	Bad Input	\\DPIH-Historian\AIGLEHG01CC01mRendCalcJN;UOM="%"
			Rendement mesuré groupe	Excluded	
			Retombée relais DVT	0	\\GREPS01SI04UL01\AIGLEHG01CC01seXARTbDVT

QUESTION 3

How to extend PI System features ?

PI tags usage

- Tag usages are collected from various sources :
 - PI AF, PI Vision, Predictive Analytics and few EDF Hydro systems
- Provide insights on where these PI tags are used
- With tag additional information
 - First and last value timestamp, tag frequency



Usage des tags :

Ne visualiser que les tags sans usage :

Items/page : 50

Environnement	Data Serveur	Tag	Source	Chemin	Usage	Info. supp.	Vérification	Date dernière valeur
Prod		G.MAIHG01AL01mPa	Prex		PuissanceBrute G_MAIHG01AL01mPa	Ecart Puissance active brute / atten...	01/10/24 15:06	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\DPIH\EDF\DPIH\UNITE ALPES\GEH ECRINS VERCORS\GU GRAND-MAISON\GRAND-MAISON\G.MAIHG01AL01mPa	PortailPS	Portail P&S	01/10/24 23:55	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\METIERS\Modèles\Pap\G.MAIHG01_Pap\Puissance active groupe	Pap	Puissance apparente	01/10/24 23:55	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\METIERS\Référentiels\Equipements\G.MAIHG01\Puissance active groupe	MetiersGroupe	Arbre METIERS Groupes	01/10/24 23:55	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\METIERS\Référentiels\Equipements\G.MAIHG01GU01\Puissance active groupe	MetiersGroupe	Arbre METIERS Groupes	01/10/24 23:55	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\METIERS\Référentiels\Equipements\G.MAIHG01GU01PA07\Puissance active groupe	MetiersGroupe	Arbre METIERS Groupes	01/10/24 23:55	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\METIERS\Référentiels\Equipements\G.MAIHG01GU01PA08\Puissance active groupe	MetiersGroupe	Arbre METIERS Groupes	01/10/24 23:55	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\METIERS\Référentiels\Equipements\G.MAIHG01GU01PA10\Puissance active groupe	MetiersGroupe	Arbre METIERS Groupes	01/10/24 23:55	11/09/2024 10:13:16
Prod	DPIH-Historian	G.MAIHG01AL01mPa	PiUtility	\\GREPS00SI04UX05\METIERS\Référentiels\Equipements\G.MAIHG01GU01PA11\Puissance active groupe	MetiersGroupe	Arbre METIERS Groupes	01/10/24 23:55	11/09/2024 10:13:16

Data transfer between tags

- Data transfer between 2 tags (*)
 - Checks :
 - UOM,
 - Point Source,
 - tags usage,
 - source last value < target first value...

Transfert de données de tag

+ Nouvelle demande Génération de demandes

Transfert d'historique
VLEREHS01CC01mSeArtGpNPr VLEREHS01CC01mSeArtGpNPrHrEti

Statut de la demande: Demandée

Tag	Description	Unité	Signal	Point Source	Dernière donnée	Date dernière donnée	PLEX3
VLEREHS01CC01mSeArtGp	Seuil d'arrêt du groupe non prioritaire	m3/s	ANA	UFL_LOIREG	67	23/07/2020 10:40:09	Non
- VLEREHS01CC01mSeArtGp	Seuil d'arrêt du groupe non prioritaire hors éta...	m3/s	ANA	UFL_LOIREG	67	12/09/2024 09:42:31	Oui

Visualiser les données

Sujet	Commentaire
Type de signal	Le type de signal correspond
FirstValues-LastValues	Les données sources vont écraser des données de la cible.
TagUse	Aucun usage trouvé.
Périodes de données	Les périodes de données présentent un écart, une donnée indiquant cet écart sera positionnée à la date: 23/07/2020 10:40:10 <ul style="list-style-type: none">• Dernière donnée source: 23/07/2020 10:40:09• Première donnée cible: 09/09/2020 16:19:32

ATTENTION: Le tag source sera supprimé Mode d'écriture des données à transférer: Insertion des nouvelles valeurs uniquement

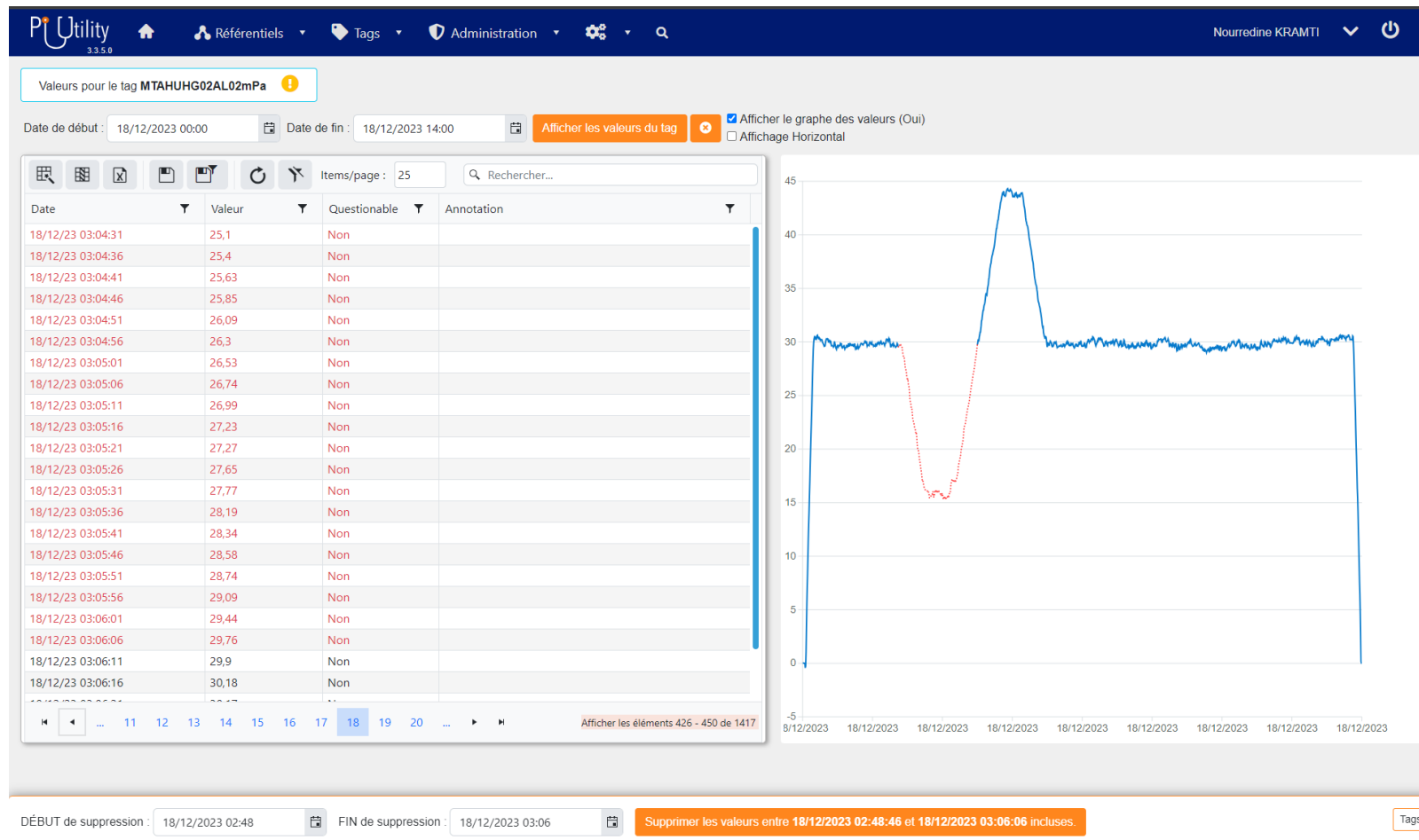
Commentaire administrateur

Pas de commentaire

Retour

Invalidate events between two timestamps

- Invalidate events between two timestamps (*) and set an invalid data Digital state with annotation at the beginning of the period



Archived events manipulation

- Add, edit or delete PI tag values (*)
- Import data from CSV files (*)

The screenshot displays the Pi Utility interface for managing archived events. The top navigation bar includes the Pi Utility logo (version 3.3.5.0), a home icon, and menu items for Référentiels, Tags, Administration, and a search icon. The user's name, Nourredine KRAMTI, is shown in the top right corner.

The main content area shows the tag name "MTAHUHG01TU01mDbtTb" in a search field. Below this, there are several action buttons: "Valeur horodatée", "Import CSV", "Affichage ligne/colonne", "Trier", and "Visualiser des valeurs PI pour une période".

The central part of the interface contains a table of archived events. Each row represents an event with a timestamp, a value, and a delete button (marked with 'X'). The values are 8,5, 8,3, 8,4, SUPPRIMER, SUPPRIMER, 8,4, 8,5, and 8,4. The timestamps range from 20/02/2024 17:55 to 19:23.

At the bottom right, there are two buttons: "Ajouter si n'existe pas" and "Enregistrer les valeurs".

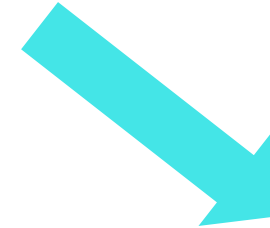
Timestamp	Value	Action
20/02/2024 17:55	8,5	X
20/02/2024 17:56	8,3	X
20/02/2024 17:57	8,4	X
20/02/2024 18:00	SUPPRIMER	X
20/02/2024 18:04	SUPPRIMER	X
20/02/2024 19:09	8,4	X
20/02/2024 19:10	8,5	X
20/02/2024 19:23	8,4	X

Additional features



- Visualize PI Web API statistics from all instances
- Data exports to various systems and formats
- Tag lifecycle history (renamed, deleted...)
- Abacus management (used by PI AF & PI Analysis)
- AF Template consistency check between PI databases
- Data transfers between PI environments
- ...

```
{
  "SnapshotTimeStamp": "2024-09-17T12:20:37.4429433Z",
  "Requests": {
    "/search/uploads/settings": {
      "Methods": {
        "GET": {
          "Counts": {
            "0": 6459,
            "10": 1,
            "50": 1,
            "100": 2,
            "250": 1,
            "500": 0,
            "750": 0,
            "1000": 0,
            "5000": 0,
            "30000": 0,
            "60000": 0,
            "120000": 0
          },
          "CountByUser": {
            "6464": 6464
          },
          "CountByStatusCode": {
            "200": 6464
          }
        },
        "Total": 6464,
        "LastObservedTime": "2024-09-17T12:16:04.93",
        "AvgTimeToFirstByte": 0.73
      }
    },
    "/streamsets/{webId}/recorded": {
      "Methods": {
        "GET": {
          "Counts": {
            "0": 811395,
            "10": 51363,
            "50": 8731,
            "100": 2194,
            "250": 462,
            "500": 108,
            "750": 32,
            "1000": 44,
            "5000": 0,
            "30000": 0,
            "60000": 0,
            "120000": 0
          },
          "CountByUser": {
            "282840": 282840,
            "591486": 591486
          },
          "CountByStatusCode": {
            "200": 874329
          },
          "Total": 874329,
          "LastObservedTime": "2024-09-07T02:05:10.69",
          "AvgTimeToFirstByte": 4.075
        }
      }
    }
  }
}
```



Url	Verbe	Nb d'appels	LastObservedTime	AvgTimeToFirstByte
/elements/{webId}/attributes	GET	157 200	01/09/2024 16:55:03	10,503
/search/uploads/{itemGuid}	POST	867	29/08/2024 12:34:26	1443,223
/search/settings	GET	133 539	01/09/2024 21:59:09	0,524
/search/uploads	POST	867	29/08/2024 12:34:25	2,528
/dataservers/{webId}/points	GET	237 470 973	01/09/2024 21:59:07	4,06
/elements/{webId}/paths	GET	1 834	27/08/2024 09:58:22	17,849
/streams/{webId}/recorded	GET	301 599	01/09/2024 21:58:40	112,581
/streams/{webId}/recorded	POST	157 096 675	01/09/2024 21:59:07	4,381
/streams/{webId}/plot	GET	17 174	01/09/2024 21:57:03	36,368
/admin/{resourcePath}	GET	114	22/08/2024 13:28:44	0,379
/system/metrics/requests	GET	37	31/08/2024 22:00:00	1,465
/dataservers	GET	2 246 961	01/09/2024 21:59:07	16,207
/	GET	18	22/08/2024 11:31:18	0,85
/streams/{webId}/interpolated	GET	6 494 733	01/09/2024 15:45:34	8,694
/search/store	PUT	400 319	01/09/2024 21:59:32	590,913
/attributes/search	GET	2 493	21/08/2024 14:18:15	1074,985
/dataservers/{webId}	GET	1	31/07/2024 15:35:36	252
/streams/{webId}/recordeddatetime	GET	25 757	01/09/2024 15:45:34	58,94
/search/sources	GET	133 540	01/09/2024 21:59:09	0,82
/streams/{webId}/summary	GET	174 898	01/09/2024 15:45:34	43,935
/assetdatabases	GET	495	01/09/2024 07:50:01	168,021
/assetsservers/{webId}	GET	2	12/08/2024 11:16:37	3
/search/uploads/settings	GET	401 186	01/09/2024 21:59:32	0,493
		Total d'appels: 719 613 353		Moyenne : 126,93

Results

Results

- Teams
 - PI System :
 - 2 development engineers focused on PI Utility
 - 2 engineers dedicated to managing AF templates
 - 1 team Leader
 - Hydro monitoring & performance communities :
 - 8 engineers
- Achievements since 2021 :
 - Developed **92 AF templates**, with **~16,000 instances deployed** in production by Michael, resulting in 21,000 tags created
 - Created **29 AF templates to synchronize ~14,000 EDF Hydro assets** with the AF hierarchy
 - Released **67 versions of PI utility**
- Success Factors :
 - Leveraging the openness of the PI System
 - Effective design of PI Utility, enabling :
 - Easy scalability : possibility to deploy thousands of instances of an AF template which is almost impossible manually
 - Reduction of human errors (Tags and instances naming, parameters settings between Ancillary and Production systems)
 - Huge time savings for both the PI System team and the Hydro monitoring community
 - Seamless addition of new features when we need them

Future considerations

What's next for PI Utility?

- Implementation of new compression settings on existing archived events using swinging door algorithm
- Implementation of data retention policies per tag
- Integration of Predictive Analytics template instances deployment from PI Utility
 - Requires upcoming evolutions on AVEVA Predictive Analytics
- Automation of AF template instances attributes configuration
- ...

Testimonials from the Hydro monitoring & performance communities



Vincent F.

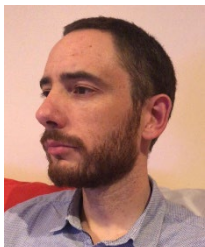
“PI Utility is an exceptional ergonomic tool that simplifies the creation and management of industrial data with remarkable efficiency and reliability”



Mathieu G.

“PI Utility helps improve monitoring and analysis by quickly and easily developing new user-specified models.

Data creation is instantaneous, reliable, provided with history, named according to a standard and controlled.”



Frédéric G.D.

“The strength lies in offering, through the PI System, technical solutions that improve overall efficiency by focusing development teams on new challenges rather than deployment tasks. PI Utility has enabled the multiplication of use cases and quick gains without overly taxing development resources. I think it is a great success.”



“PI Utility is a simple and effective interface to manage our monitoring data. This is a huge time saver on a daily basis and a guarantee of long-term maintenance of our models.”



Michael B.

“By allowing us to have control over creating new PI tags calculated from existing tags, PI Utility has significantly improved our ability to detect and analyze operating deviations in our hydroelectric facilities. It allows us to develop other operating services such as assistance in carrying out condition-based maintenance.”



Guilhem T.

“PI Utility is an essential tool for us to develop advanced calculation and visualization within PI. Without this tool, our performance monitoring project would not have succeeded. It allows us to easily and flexibly manage PI AF calculation models by non-IT staff without in-depth knowledge of PI.”



Jean H.

EDF Hydro reduces the time needed to deploy AF models instances

Challenge

- Minimize the time spent to deploy AF template instances and enable users to do it
- Automatically generate AF hierarchies from the company's asset repositories
- Extend PI System features

Solution

- Development of PI Utility, a Web Application (.Net 8 C# , Blazor Server and Microsoft SQL Server) interconnected to EDF Hydro asset repositories and the Ancillary and Production PI Systems

Results

- With a team of 6 Hydro monitoring engineers and 5 PI & development, we could deploy 92 AF models and almost 16K AF template instances in production. It took 80% less time to deploy them compared if we had to do it manually.
- The development of PI Utility was financed by the time we saved in deploying instances. We had a huge gain in agility, efficiency and quality.



Presenter



- Jérôme BOUDON
- EDF SA, Hydro Division
- PI System Hydro Project Manager
- jerome.boudon@edf.fr



EDF was an actor in that innovation!

Q&A



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