

Nuclear Energy @ IN2P3

Sylvain David – chargé de mission Energie Nucléaire IN2P3

« outward » presentation : nuclear context, collaboration, joint programs
Coupled with Annick's presentation « inward », projects and teams

New nuclear context and impact on R&D programs

Role of « chargé de mission » nuclear energy @ IN2P3

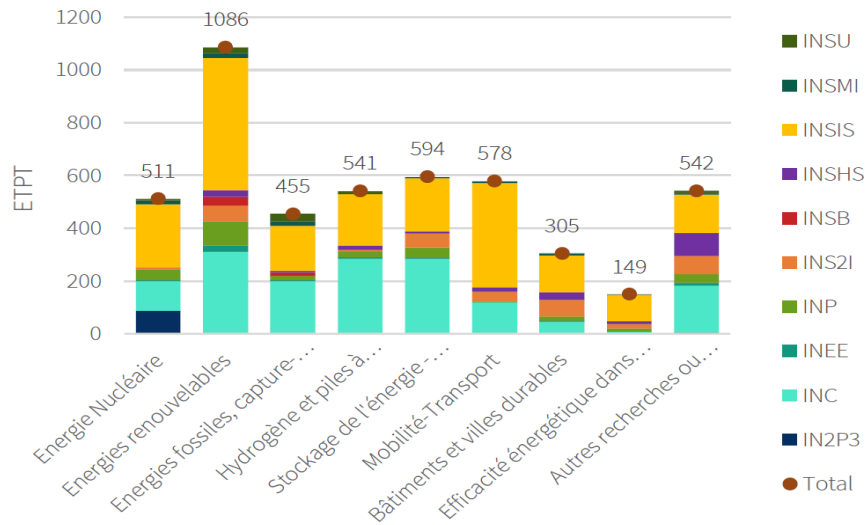
- **Program NEEDS**
- Supporting projects for external founding
- Representing IN2P3 in different structures

Nuclear context, past / present / future

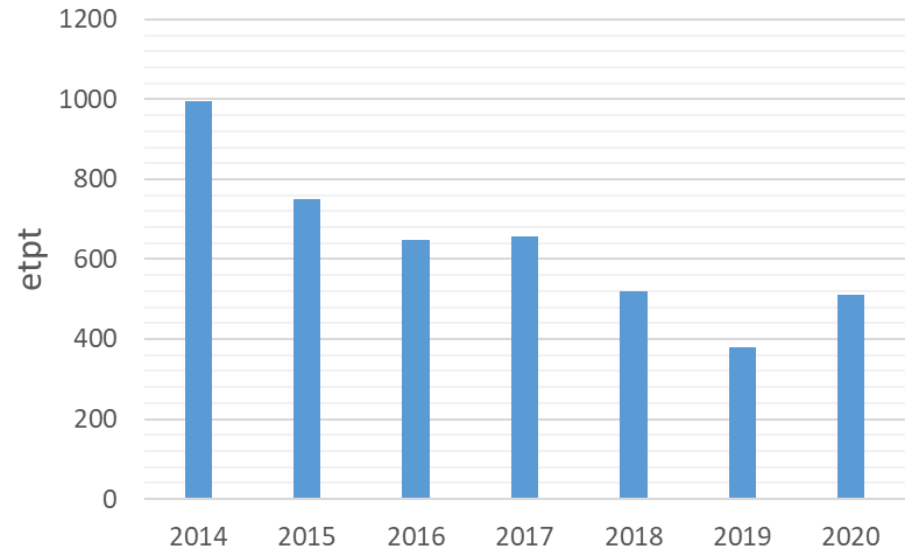
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- 1991** French law about « new options for nuclear waste management »
first CNRS programs (1995) : transmutation by accelerator-driven systems, new materials for waste storage, nuclear data (spallation, MA), thorium cycle, ...
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- 2006** End of the 1991 law
- Priority on fast sodium reactors (breeders), prototype (ASTRID) for 2020
 - Priority on geological disposal in the law (CIGEO)
- Evolution of CNRS activities
- Maintaining an active but reduced activity on innovative systems (ADS, molten salt, ...)
 - Exploring the capacities of « standard » reactors for innovative fuel cycles (PWR, sodium, ...)
 - Developing more generic/basic research on fundamental process taking place in reactors (neutronics, nuclear data), waste disposal, environment, ...
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- ~2020** ASTRID project is stopped / Mox recycling in PWR is considered
Public debate on nuclear waste disposal and the come-back of the transmutation of waste
US start-ups in the nuclear energy field / SMR /small is beautiful
- 2021 : France Relance « innovative options for nuclear waste management and alternative to geological disposal »
 - 2022 ? France relance 2030 « new nuclear systems »
-

3

Energy survey at CNRS (UMR)



Nuclear energy in UMRs



After normalization by the « return rate »
 ~ -30% in 5 years

IN2P3 tools for nuclear energy activities

Scientific Deputy Directors

Direct IN2P3 support, master projects, structuration, CNRS calls (interD, prime, ...)

GDR SCINEE « Nuclear Sciences for Energy and the Environment »

See Annick Billebaud

« Chargé de mission » nuclear energy

- Program NEEDS management
- Supporting projects for external founding
- Representing IN2P3 in different structures
 - Commission Nationale d'Evaluation
 - Cellule Energie CNRS
 - ANCRE / GP énergies nucléaires
 - International Institut of Nuclear Energy
 - Euratom

Nuclear energy @ IN2P3 different ways to work on it

« Science Driven » Up-stream approach

Understanding the fundamental processes occurring in the « objects » of nuclear energy

Basic data

Models & simulation

Long-term involvement of the teams, appropriation of the problematics, transform « industrial needs » into « scientific questions », scientific strategy of IN2P3 (scientific prospective 2021)

CSI2022

- Neutronics / reactors physics / multi-physics approach

CSI2022

- Nuclear data for reactors

CSI2016

- Material science and irradiation effects

CSI2016

- Radiochemistry for fuel cycle and environment

NEEDS
program

Interactions with « society »

Teaching (university / engineering schools)

« Outside the box » Exploring innovative systems or innovative fuel cycles Innovative

CSI2022

- Systems for nuclear waste transmutation or energy production, fuel cycles

CSI2016

- New materials for waste management or for reactors

NEEDS
program

« Energy Transition » and role of nuclear power

Energy mix analysis / coupling physics and economy / sociological approach

Expertise for society, nuclear waste management , transmutation, ...

NEEDS
program

« Applied science » Innovation / transfer Applying methods/tools/instrumentation

developed for fundamental science to nuclear energy applications

Exemple : neutrinos for reactor controls, muons for uranium deposit, ...

Punctual interaction with industrial partner / identify the opportunities / help to transfer

NEEDS program

Joint research program since 1995 : PACE / PACEN / NEEDS 2012-2019

New program NEEDS 2020 – 2024

CNRS : IN2P3 INC INSU INSIS INEE INSHS INSMI

+ CEA IRSN ANDRA EDF FRAMATOME ORANO BRGM

Objectives

- Mobilizing « academic research » on scientific questions related to nuclear energy
- Insuring an effective interaction between the « industrial needs » and the related « scientific questions »

2 types of projects

- Structuring project 20-150k€/y + PhD
 - Strategic questions identified
 - Common will of mobilizing the « known » academic teams
 - Pluri-annual projects 2-4 years
- Exploratory projects 5-20k€/y during 1 or 2 years
 - Mobilizing « unknown » teams
 - Test of new ideas
 - Open call

NEEDS

2021

- Scientific animation, workshop, building new projects, ...
- September : Call « exploratory projects » opened
- October : Exploratory and Structuring projects received
- Evaluation by the Scientific Comity
- November : arbitration by the Steering Comity
- December : final decision par the Partners Comity

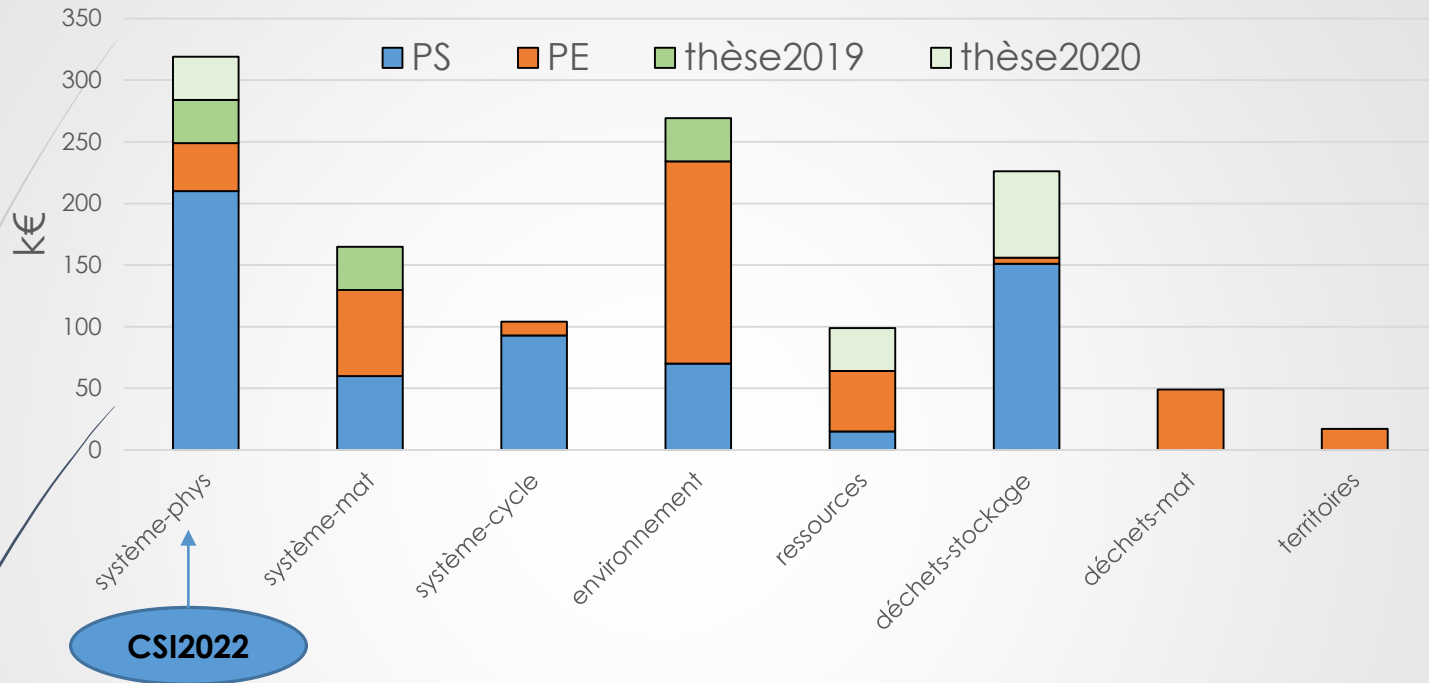
2022

- funding

Budget : CNRS ~250 k€ + 3-4 PhD / Parnters ~750k€ = ~1000k€/y + 3-4 PhD
~80 etpt in CNRS-UMR and ~25 in partner teams (CEA+IRSN+BRGM)
~12 structuring projects ~650 k€
~20 exploratory projects ~300 k€

NEEDS

Budget global par thématique



Projects 2022 led by IN2P3 concerned by this CSI (physics part)

- Nuclear Data for reactors (PS NACRE)
- Sensitivity uncertainty for depletion calculations (PS SUDEC)
- Basic methods in neutronics (PE MADIFF)
- New approaches in experimental reactor physics (PS SUCRE)
- Fuel cycles and Pu management in PWR and FBR (PS CINEASTE)

Past projects MSR-PIRT (molten salt), OKLO'50, ...

From the 1991's law to France Relance (2021)

PNGMDR : national roadmap of radioactive material and waste management

Public debate on nuclear waste disposal and the come-back of the transmutation



- **Thématique 1 : Optimisation de la gestion des déchets et meilleure structuration des filières de gestion** : développement de procédés et de techniques innovants permettant d'optimiser la gestion des déchets radioactifs, de manière proportionnée en regard des enjeux afférents.
- **Thématique 2 : Valorisation des matières radioactives** : développement de procédés et techniques innovants permettant le recyclage et la valorisation des matières radioactives dont les perspectives d'utilisation dans la filière nucléaire ou hors nucléaire s'inscrivent à moyen et long terme.
- **Thématique 3 : Solutions alternatives au stockage géologique profond** : identifier et explorer des solutions de gestion des déchets de haute activité et moyenne activité à vie longue alternatives au stockage géologique profond au regard des progrès actuels et des innovations possibles.

CSI2022



French Investment Bank (BPI) + Scientific coordinator ANDRA
New organism for research funding at IN2P3

Theme 3 : 2 projets built with IN2P3 support

ISAC

Innovative System for Actinide Conversion (molten salt, chloride)

Partners : CEA CNRS ORANO FRAMATOME EDF

Budget total = 26M€ (4y), 14 M€ from BPI, ~3 M€ for CNRS teams (marginal cost)

IN2P3 INC INSIS – 6 PhD + 8y post-docs

Physics : sensitivity to nuclear data, neutronic behaviour in operation, safety analysis, scenario studies, multi-physics approach (neutronics/thermalhydraulics coupling) models and experiments

SPATIAL

ADS – experimental methods to measure the subcriticality level of a transmuter ADS

CNRS/IN2P3 project, budget 2 M€ (marginal cost)

Physics : accelerator R&D, neutron flux measurement, basic neutronics understanding, validating an experimental method able to measure online the subcriticality level of an ADS, without using the « critical » reference

Coming soon...



Plan de relance :
investir pour préparer
la France de 2030



Commission Nationale d'Evaluation

Evaluation of the research activities in the framework of the laws of 1991 and 2006

- Waste storage
- Transmutation
- Innovative systems, Pu management (PWR, FBR, ...)

Annual report for OPECST + DGRI + DGEC

- Annual evaluation « upstream research »
 - NEEDS activities and structuring projects
 - CNRS position on transmutation
 - « France relance » projects
- Private audition of CNRS

CNE remains an important structure for IN2P3 activities on innovative reactors, nuclear waste storage and transmutation, basic research in reactor physics, fuel cycle analysis, ...

Cellule Energie CNRS + ANCRE

Euratom program

International Insitut for nuclear Energy I2EN

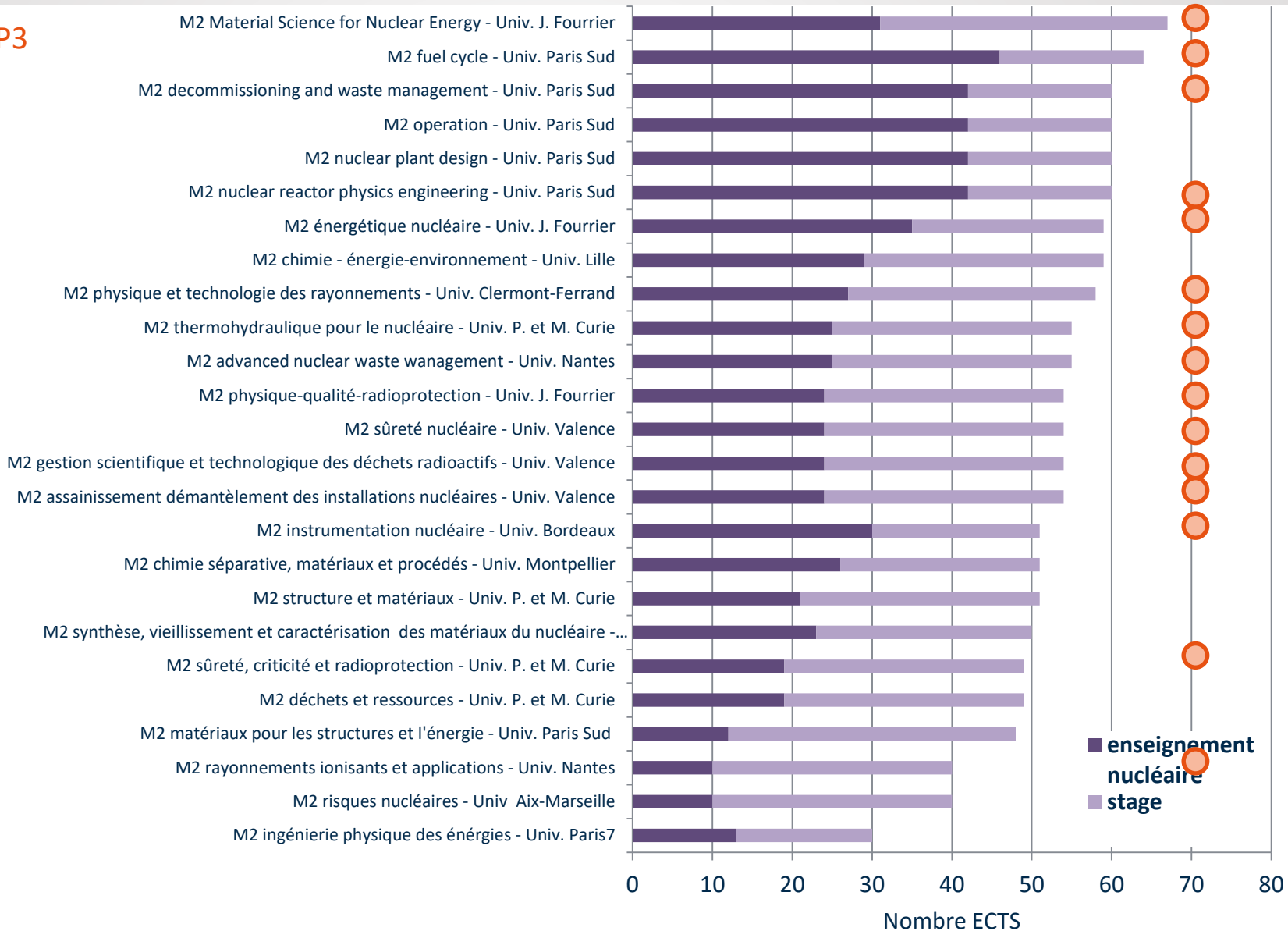
Missions

- international : support the french nuclear industry in terms of teaching / training
 - Internships, foreign students
 - « Train the trainers »
- national : identify / evaluate / labelize nuclear training programs
 - Help the collaboration between industry and académic teams leading the training programs
 - Strong involvment of IN2P3 teams
 - Strong correlation between the quality of the training program and the fact that the leading team works specifically on nuclear energy projects

12 vocational bachelor (L Pro) « nuclear energy », 7 led by IN2P3 teams
25 master « nuclear energy », 15 led by IN2P3 teams

International Insitut for nuclear Energy I2EN

Porté par
UMR IN2P3



ISTE

Collection Energie confiée au CNRS (A. Dollet)

Série Nucléaire : IN2P3

Du noyau au réacteur, 2 tomes

O. Méplan, X. Doligez, S. Bouneau + J. Colin, A. Nuttin, ...

L'économie du nucléaire

N. Thiollière, J. Percebois + ...

Matériaux sous irradiation

N. Moncoffre, S. Bouffard + ...

+ technologies de réacteurs actuels et futurs

+ la fusion nucléaire

+ chimie du cycle, de l'amont à l'aval

+ impact environnemental

+ ...

<https://lejournal.cnrs.fr/articles/sciences-une-encyclopedie-contemporaine>

Coming
soon

« Sciences », une
encyclopédie
contemporaine

02.10.2020, par Muriel Florin

