

SPES Project in 2013 and 2014

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0) Executive Summary

The principal points treated in this document can be summarized as follows:

- a) During 2013, the project was financed with 2.6 M€. These funds are part of the SPES-MIUR-2011 “Premium Project”, financed by Ministry with 5.6 M€. At the end of the year there is a residue of less than 0.1 M€ (4% of the assignment).
- b) Part of the above expenses (470 k€) has been devoted to hire Personnel in formation for a total of 26 person-years.
- c) In addition, during 2013, the project has been granted, in synergy with other LNL projects, three Post-Doc two-years contracts, for a cost of about 0.5 M€.
- d) During 2014, the project will take advantage of an in kind contribution of about 0.9 M€, coming from the synergies with other LNL projects, to start the RFQ construction.
- e) During 2014 the following funds are necessary (in addition to the re-assignment of the 2013 residues):
 - a first tranche of 3 M€, completing the funding assigned for SPES-MIUR-2011 “Premium Project”,
 - a second tranche of 4.5 M€, to be covered by specific INFN or Ministry funds.
- f) In the second part of 2014, at least 6 technicians should be hired to start cyclotron installation and operations.

1) Global financial picture

In December 2012 a planning document for the realization of the SPES project (121203_I_00_av_n_pianificazione SPES_Inglese.pdf) was presented to the INFN Management Board. The project main goal is to provide high intensity and high quality beams of neutron-rich nuclei by employing: ISOL technique, high resolution mass selection and the superconducting linac ALPI acting as re-accelerator up to 10* Λ MeV. A global cost of 51.1 M€ has been estimated. An amount of 20.5 M€ has already been invested mainly for building, infrastructures and cyclotron (2010-2012).

For the project completion, a five year plan was proposed (2013-2017) with a cost of 30.6 M€ (see table 1.1):

- a) In order to realize a starting version (CORE_SPES), without high resolution mass selection, 27.9 M€ are needed.
- b) Further 2.7 M€ are necessary to add the high resolution mass selector (FULL_SPES).

Table 1.1
Estimated costs of the SPES project

	M€
ISOL target and laser source	3.2
Building and infrastructures for UCx laboratory	2.6
Radioactive ion beam transport	7.7
High resolution mass separator (HRMS and Beam Cooler) (only for FULL_SPES)	(2.7)
Charge Breeder	1.5
RFQ for pre-acceleration	3.7
Upgrade of the ALPI linac (low beta, cryogenic controls, layout)	5.6
Controls and safety systems	3.6
TOTAL	27.9 (30.6)

SPES was approved by Ministry for Education, University and Research (MIUR) as a “Premium Project 2011” with a financing of 5.6 M€

Other sources of indirect funding for a total of 7.2 M€, come from:

- a) Synergies with others LNL projects to build the RFQ with a saving of 3.2 M€.
- b) Saving on electric energy for reduced operation time of ALPI in the period of installation of SPES (200 k€/month x 20 months), 4.0 M€.

The total amount of available funding is 12.8 M€. To finance SPES_CORE, additional 15.1 M€ are needed. INFN has already requested this sum to MIUR, in the framework of the reformulation of “Bandiera Projects”.

2) Project schedule

According to the document presented to INFN Management Board, the schedule for SPES realization is shown in table 2.1:

*Table 2.1
General schedule for SPES project*

	2012	2013	2014	2015	2016	2017
<i>Authorization to operate and safety</i>	<i>UCx 5 microA</i>	<i>Full UCx</i>	<i>authorization</i>			
<i>ISOL Target-Ion Sources development</i>						
<i>ISOL Targets construction and installation</i>						
<i>Building Construction</i>	<i>project</i>	<i>Raw construction</i>		<i>completion</i>		
<i>Cyclotron Construction & commissioning</i>			*			
<i>Re-accelerator: RFQ development and ALPI up-grade</i>						
<i>Design of RIB transport & selection</i>						
<i>Construction and Installation of RIBs transfer lines, CB and spectrometers</i>						
<i>Complete commissioning and first exotic beam</i>						

*Expected arrival of the cyclotron at LNL

The SPES project entered the construction phase in 2012. In particular, the main milestones achieved so far and expected for 2014, were the following:

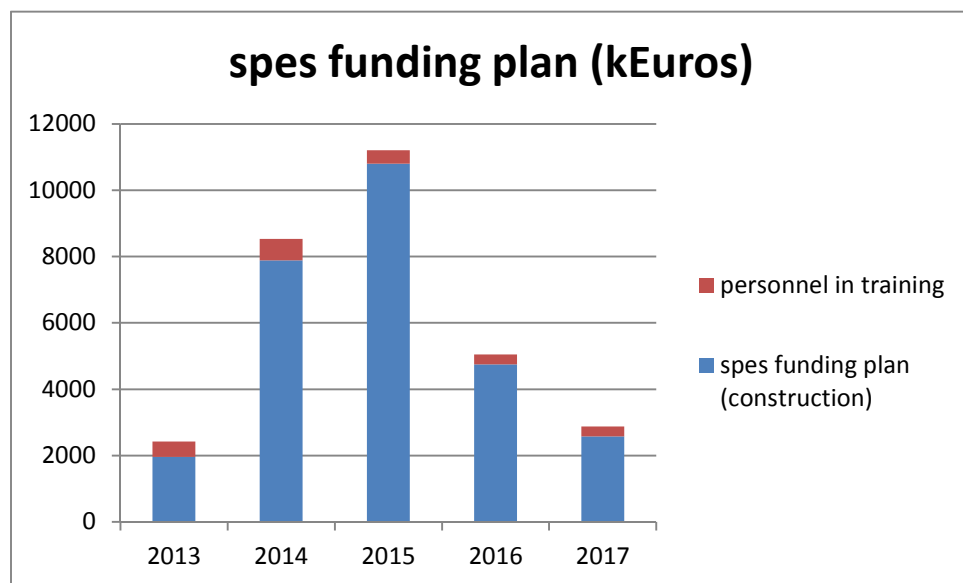
2012 approving the cyclotron to be constructed by BEST and assigning the bid for new building;
 2013 starting excavation for new building;
 2014 starting construction of Charge Breeder, transfer- beam selection line; completion of ISOL target-ion source.

The economic plan to complete CORE_SPES is reported in table 2.2.

Table 2.2
SPES funding plan (k€)

	2013	2014	2015	2016	2017
CONSTRUCTION (27974 k€ to complete CORE_SPES)	1958	6988 900*	8502 2300*	4751	2575
PERSONNEL (IN TRAINING)	467	653	400	300	300
Total	2425	8541	11202	5051	2875

*contribution to RFQ construction



3) Main results and milestones during 2013

The main results achieved during 2013 are summarized in the following:

- Realization of the excavations for the new building (for cyclotron, ISOL targets, irradiation bunkers, HRMS and laboratories).
- Cyclotron construction at BEST (Canada): the machine has been assembled with magnet, source and RF cavities. Initial tests are on-going.
- Characterization of ISOL sources and UCx preparation in conjunction with ENSAR JRA Actilab.
- Preparation of laser laboratory and beginning of tests.
- Design of the remote handling machine for ISOL target, based on Automated Guided Vehicle, and purchase of the AGV itself.
- Design of the radioprotection Access Control System for ALPI and “III experimental room” areas.
- Design of the digital RF control system for accelerator resonators.
- Design and purchase of the PLCs to upgrade the cryogenic control system, based on UNICOS (CERN).
- Bids for laser system (selective ionization ion source) and ISOL bunker shielding doors started.
- Vacuum tests for a module of radioactive beam transfer line were performed. The electrostatic triplet module was re-designed and the prototype was ordered, as well as the vacuum system module.

4) Expense commitments during 2013

During 2013 the SPES project received a first tranche of funding (2.517.000 €), coming from the “Premium Project” SPES-MIUR and an additional 100.000 € to extend the building project for medical applications (LARAMED) (see table 4.1):

*Table 4.1
Summary of 2013 budget*

Item	Assigned (k€)	Used (k€)	Residues (k€)
TRAVEL EXPENSES	100	77	23
SERVICES	27	27	0
CONSUMABLES	50	50	0
DURABLES	92	88	4
APPARATUSES CONSTRUCTION	1383	1382	1
BUILDINGS	350 +100	334 +100	16
PERSONNEL (IN TRAINING)	515	467	48
TOTAL	2617	2525	92

The main expenses for systems and significant devices, during 2013, are reported in table 4.2.

*Table 4.2
Main items of expenditure for systems and significant devices in 2013*

	k€
ISOL_ Laser system for selective ionization ion source	732
ALPI_ new controls of cryogenic system	355
BUILDINGS_ shielding doors for ISOL bunker	300
VACUUM_ prototype vacuum system for SPES beam transfer line	100
CONTROLS_ dedicated Ethernet network and EPICS archiver	64
Total	1551

Table 4.3 presents the expenses during 2013 broken down according to the SPES Work Packages.

Table 4.3
Analysis of 2013 Work Package expenses

Work Package	Main items	(k€)
ISOL beams	Laser ion-source and ISOL laboratory	860
Alpi	Cryogenic system and controls	355
Buildings	Shielding doors, infrastructure “III sala”	340
Vacuum	Prototype vacuum system for beam transfer line	100
Controls and safety	Control system dedicated Ethernet network, EPICS	67
Diagnostic	Prototype of diagnostic box	49
Beam Transport	Electrostatic triplet, vacuum chamber	41
Charge Breeder	1+ source	30
Radiation protection	Instrumentation for dosimeters reading	32
Scientific support	Material for tape system	7
Travels Cyclotron	Follow up cyclotron construction	19
Travels	Contacts and collaboration exchanges	58
	Total	1958

For training personnel a number of Fellowships and Grants have been funded, as shown in table 4.4.

Table 4.4
Funding for training scientific and technical personnel, 2013

	k€
4 two-years technical training fellowships for young undergraduates	104
3 two-years training fellowships for young graduates	117
2 three-years PhD grants	110
1 two-years Research Allowance grant for SPES “Quality and Safety Management System”	46
1 two-years Research Allowance grant for “Accelerator control system”	46
1 two-years Research Allowance grant (co-funded Florence Univ.) for “Physics of SPES”	44
TOTALE	467¹

¹ To be added: 20k€ for a grant to Palermo University for Safety System and risk analysis.

In addition, in synergy with other LNL projects, SPES had three two-years Post-Doc temporary contracts (Art.23) for Charge Breeder, Cyclotron and Radiation protection; for a total funding of about 500 k€.

In total around 2.6 M€ of the “Premium Project 2011” were used.

5) Analysis of budget residues 2013

On the assigned budget of 2617 k€ for 2013, at the end of the year, there was a residue of 92 k€ (4%). Table 5.1 gives details about these residues.

*Table 5.1
Analysis of residues 2013*

	k€	
Travels	23	These funds are set aside to cover the collaboration expenses with iThemba-Labs (South Africa). A power test of the ISOL target, planned for 2013, was in fact shifted to February 2014 .
Buildings	16	Physiological
Apparatuses	1	Physiological
Durables	4	Physiological
Training personnel	48	These funds are set aside to cover: <ul style="list-style-type: none"> • a contribution of 20k€ to Palermo University for a post-graduate grant on risk analysis • one-year Research Allowance for cyclotron RF.
Total residues	92	

6) Milestones for 2014

In the following, we report the main milestones expected in 2014:

- New building available at raw with plants for cyclotron installation.
- Cyclotron installation and start of acceptance tests.
- Charge Breeder construction.
- Set-up and off -line test of the tape system.
- Installation of 1+ source and beam line for Charge Breeder.
- Installation of ALPI radioprotection control access system.
- Installation of new controls for the cryogenic system.
- Design of Medium Resolution Mass Separator (downstream the Charge Breeder).
- Design and partial installation of safety and control systems for cyclotron operation.
- Design of storing system for exhaust vacuum gas.
- Bid assignment for laser system, shielding doors, cryogenic controls.
- Bid for vacuum systems.
- Bid for components of Medium Resolution Mass Separator.
- Bid for diagnostic boxes.

7) Economic and activity program for 2014

The planned economic program for 2014 is reported in table 7.1, subdivided according to the SPES items.

*Table 7.1
Planned expenses for SPES, 2014*

Task	Item	(k€)	notes
Scientific support	Radioactive beam identification	83	Tape system instrumented with gamma-beta detectors and ACQ
Radiation protection	Radiation monitors	500	Design of radiation monitor system for cyclotron operation
Buildings	General services and plants	200	Distribution of services in cyclotron and ISOL areas
ISOL beams	ISOL laboratory and Laser source	100	Measurements and optimization of ion sources and ISOL front-end
Beam Transport	CB-RFQ beam line	1700	Design and order of MRMS components and n+ CB beam line
Beam Cooler	BC test stand	100	Set-up of BC vacuum chamber and test stand
Cyclotron	Installation	200	Cyclotron connection to electric power and services
RFQ (in-kind contribution LNL)	First tranche of materials and machining for RFQ development	(900)	This item comes as in-kind synergy with others LNL projects.
ALPI	Cryogenic system	345	New valve box purification system
Diagnostic	Diagnostic Box	670	Order of 20 low current diagnostic boxes
Charge Breeder	Power supplies, 1+ beam transport elements	650	Construction of CB. Installation and test of 1+ ion source.
Vacuum	Vacuum systems for 1+ radioactive beam line	1550	Order of 20 vacuum systems
Controls	ALPI access control system RF and CB controls	640	Installation and commissioning of new Access Control system for ALPI. Design and order of

			controls for RF and Charge Breeder.
Training personnel		653	
Consumables		70	
Travels		80	
Other services		100	External services for installations
TOTAL		7641 (+900)	

As shown in the table, the resources for the RFQ construction will come from synergies with others LNL projects.

The item “training personnel”, for a total of 653 k€, accounts for:

		k€
1 one-year post-doctoral grant to Palermo University	SPES safety system	20
4 two-years technical training fellowships for young undergraduates	Mechanics and electronics	104
1 two-years training fellowships for young graduates	ISOL target remote handling	39
1 two-years training fellowships for young graduates	Beam dynamics	39
1 three-years PhD grant	Mechanical developments and vacuum systems	55
1 three-years PhD grant	FLUKA simulation for beam production and radioprotection	55
1 two-years Senior Research Allowance grant	Cyclotron RF	67
1 two-years Senior Research Allowance grant	Reacceleration bunchers	67
1 two-years Research Allowance grant	ISOL target material development	46
1 two-years Research Allowance grant	Diagnostic systems	46
1 two-years Research Allowance grant	Control systems	46
1 two-years Research Allowance grant	SPES physics	46
1 one-years Research Allowance grant	SPES physics	23
	Total	653

In total, for the year 2014, about 7.6 M€ (plus 0.9 M€ to start the RFQ construction) are necessary.

It must be observed that, at the end of **2014, it will be necessary to hire at least six technicians** to start the operation of the cyclotron in a regular way. Considering annual contracts, **additional 240 k€ are required.**

8) Financial plan for 2014

The 2014 budget request includes:

- re-assignment of the 2013 residues (94 k€),
- a first tranche of 3 M€ at the beginning of 2014, as completion of the funding assigned by MIUR for the Premium Project_2011,
- a second tranche of 4.5 M€, in June 2014, based on a specific new assignment from INFN or MIUR.

Table 8.1 outlines the plan of expenses:

Table 8.1
Financial plan 2014

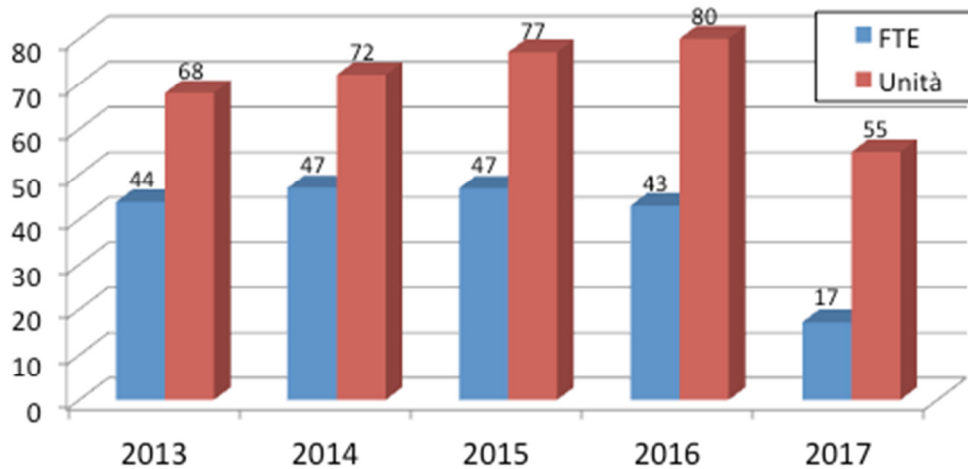
	<i>Total 2014 (k€)</i>	<i>Residues 2013 (k€)</i>	<i>First tranche 2014 (k€)</i>	<i>Second tranche 2014 (k€)</i>
PERSONNEL (IN TRAINING)	653	48	328	277
TRAVEL EXPENSES	80	23	37	20
SERVICES	100	0	50	50
CONSUMABLES	70	0	48	22
APPARATUSES	6405	1	2321	4083
DURABLES	133	4	66	63
BUILDINGS	200	16	150	34
Total	7641	92	3000	4549

The requested funding follows the plan to complete CORE_SPES in 2017.

9) Involved personnel

The personnel involved in SPES construction (see figure 9.1) is about 45 Full Time Equivalent (FTE). During 2013, 68 persons have contributed to SPES; about 40% of them are temporary employees (13 with training fellowships, 13 with temporary contracts).

Fig.9.1: Personnel involved in the SPES construction



The personnel is shared on the SPES Work Packages as shown in table 9.1 and graphically represented in fig.9.2:

*Table 9.1
SPES personnel 2013*

Work Packages	Personnel	FTE
management	5	2
controls	8	6.4
safety-radioprotection	6	4.6
infrastructures	4	2
Mechanical Engineering	4	3.5
ISOL beams	10	7.4
beam transport and selection	5	4.3
cyclotron	3	1.3
Re-acceleration	10	5.7
rfq	4	1.3
vacuum systems	4	2.9
scientific support	5	2.4
Total	68	43.8

Fig.9.2 distribution of personnel on the SPES Work Packages (2013)

