DERri
Distributed Energy Resources
Research Infrastructures

TEMPLATE FOR PROPOSAL UNDER DERRI

User-Project Proposal:

User-Project Acronym	TSFCLR
User-Project Title	Tests in SFCL Resistive
Main-scientific field	Protective Devices in Smart Grids
Specific-Discipline	Semiconductor Fault Current Limiter

Lead User of the Proposing Team:

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Activity type and legal status* of Organization	University
Position in Organization	Pre-doctor

* Higher Education Institution (1) – Public research organization (2) – Private not-for-profit research organization (3) – Small or Medium size private enterprise (4) – Large private enterprise (5) – other (specify)

Additional Users in the Proposing Team:

Name	
Phone	
E-mail	
Nationality	
Organization name, web site and address	
Activity type and legal status* of Organization	
Position in Organization	

* Higher Education Institution (1) – Public research organization (2) – Private not-for-profit research organization (3) – Small or Medium size private enterprise (4) – Large private enterprise (5) – other (specify)

(Repeat for all Users)

Date of submission	30-06-2012
Re-submission	YES________ NO___X____
Proposed Host TA Facility	RSE Italy
Starting date (proposed)	From February 2013

Summary of proposed research (about ½ page)

Prepare a ½ page summary describing the relevance and the scope of the proposed work, and the expected outcome(s)

I would propose to study the behavior of the SFCL using a microgrid based on different simulated wind turbines and/or PV cells and/or batteries (in case of electric vehicle), or others of interest. We could change these topologies.

In order to determine what tests we are going to tackle I propose (or some of them):

- Recovery time under load.
- Study of the quench.
- Harmonic distortion.
- Fault current limitation.
- Others.

State-of-the-Art (about 1 ½ page)

Describe in brief (in about 1½ pages) the current knowledge on the subject, citing recent relevant references. Identify any knowledge gaps and their relevance.

References

List relevant References

The principle of the SFCL is using transition of superconducting materials from the superconducting status to normal status. That is, the SFCL presents very little reactance under normal operating conditions; while system breaks down, the superconductor will immediately present greater reactance after the system fault current exceeds the critical current of the superconductor, which can limit the short circuit current. The principle of another SFCL is using the no resistance characteristics of superconducting materials under DC status. Such as, the magnetic saturated core type SFCL is using DC superconducting coil to generate a lot of magnetic flux which can make the core saturated. While the core, which goes out of saturation under fault conditions, will present a large reactance that can limit the fault current

The structure of resistive type SFCL is so simple that it can be just only a low temperature superconducting wire or a certain length of high temperature superconductors. The superconducting status is normal operation with little impendence. When needing to limit the over current, the superconductor goes into a quenching status. The capacity of this simple SFCL is usually not much, so it is difficult to apply in the actual power system. In order to increase the capacity and impedance, the resistive SFCL is often made of the non-inductive reactor . A current limiting resistor or reactor can be connected in parallel with non-inductive reactor, in order to reduce capacity requirement of the superconducting coil. Under normal operation, the trigger coil (TC) and the limiting coil (LC) go through half of the rated current. Under fault condition, the trigger coil which critical current is smaller quenches firstly, soon the fault current is transferred to the limiting coil.

CIGRE WG A3.16,
Electric Power Research Institute –EPRI-

Detailed Description of proposed project : Objectives – Expected Outcome – Fundamental Scientific and Technical value and interest (2-3 pages)

Provide a detailed description of the objectives of the proposed activity, the way these objectives will be fulfilled through the proposed work, as well as indications on the expected outcome and the fundamental scientific and technical value and interest of the proposal. Specify the type of TA infrastructure (distributed generation simulator; domotic house; etc.) and the test setup. With the understanding that these aspects will be discussed with the TA infrastructure after approval of the proposal and specified in the Agreement to be signed between the TA infrastructure and the User team, indicate the number of tests to be carried out and their sequence, the response quantities to be measured through the instrumentation, etc. Describe any special requirements for equipment, standards, safety measures, etc. Point out any shortcomings, uncertainties and risks for the fulfillment of the project objectives, as well as the means to mitigate relevant risks.

The objective is to perform the following test, or some of them:

Basic Lightning Impulse Insulation and Switching Impulse Level Tests

Outdoor electrical T&D systems are subject to lightning surges. Even if the lightning strikes the line some distance from the FCL, voltage surges can travel down the line and into the FCL. High-voltage switches and circuit breakers can also create similar voltage surges when they are opened and closed. Both types of surges have steep waveforms and can be very damaging to electrical equipment. To minimize the effects of these surges, the electrical system is protected by lighting arresters, but they do not completely eliminate the surge from reaching the FCL. The basic insulation level (BIL) or switching impulse level (BSL) of the FCL measures its ability to withstand these surges.

Continuous Current Test

This test runs the FCL at its rated current for several hours to ensure that it reaches thermal equilibrium. The goal is to demonstrate that the device can operate under fullload current. Manufacturers want to make sure that all connections with the FCL withstand continuous current flow thermally. Any weak connection will result in a rise in temperature or pressure build up.

Short-Time Withstand Current Tests

There are two types of short-time withstand current tests: 1) electrodynamic and 2) thermal capability. The goal of the electrodynamic test is to determine whether the device can withstand electrodynamic forces and the mechanical integrity of the device. If there is a loop or a bend in the conductor, outward mechanical forces try to expand the loop. A straight conductor would not experience these kinds of forces. The thermal capability test evaluates whether the device withstands the heat from high current and high voltage.

Breaking / Making Test

Breaking / making tests are circuit breaker (CB) tests. They only apply to FCLs that have CB functionality built into them. Breaking/making tests measure circuit breaker capabilities such as the integrated protection systems, which come with some breakers at low and medium voltages. One subset of this test is the maximum rated breaking current test. It is an FCL limitation test. The manufacturer tests at different current levels above rated current and up to the full rated fault *current. If there is a rated load current value, multiples of that would be tested, and the maximum prospective fault current for the circuit for which the FCL is designed.*

Recovery under Load

This is a new type of test that is specific to FCLs and not for circuit breakers, transformers, and other conventional devices. The reason is that superconducting FCLs need to cool down the superconductor before the device can experience another fault. The value of a FCL to the utility customer is greatly enhanced by the voltage class of the device and its ability to handle multiple faults without having to be removed from service. The latter requires that the device be able to recover to its pre-fault condition while still carrying normal load current and voltage. Load current flows through superconductor and any shunt circuitry simultaneously, while the superconductor cools down from prior heating during the fault current transient(s).

Fault Current Limitation

This test evaluates at each perspective current level how long it takes for the FCL to develop significant impedance, which in turn causes the desired voltage drop across the device, how large this voltage drop is, and whether the FCL can sustain the voltage for the specific time needed to open a breaker. Solid-state FCLs may have a feature to actively control current (similarly to household dimmer switches), which is not available with HTS FCLs; however, they both need to pass the current-limitation test.

Electromagnetic Compatibility Test

This test determines whether the device can withstand with electromagnetic interference and the amount of electromagnetic radiation it emits when it functions.

Utility Commissioning Tests

There are currently no guidelines on how utilities need to specify FCLs; therefore an FCL might be specified based on its applications. Some examples of applications include a bus tie FCL, a feeder FCL, or a generator tie FCL. For instance, a bus tie FCL might not need to recover under load; however, a feeder FCL will have tight specifications on how fast it needs to recover under load. Utilities may also have different requirements on how many faults FCLs can sustain before they can trip out or how long can they take to recover.

Originality and Innovation of proposed research – Broader Impact (1-2 pages)

Demonstrate the originality and innovation of the proposed work and the impact the expected results will have on current and future research or practice, public safety, European standardization, competitiveness, integration and cohesion and on sustainable growth.

In order to achieve technology- and market-readiness goals there is a need for testing facilities that have the flexibility to respond to the special needs of R&D projects, prototype devices, and advanced designs based on novel materials or innovative concepts. The lack of such facilities causes longer than necessary design phases, slows down the commercialization process, and increases the development cost.

There is no agreement on whether standards for fault current limiters should precede the design *or if the devices need to be designed before standards can be developed. This is because there are a number of different designs and the testing requirements differ for each. Additionally, there is no agreement on the number and type of test standards that are needed for FCLs.*

We will try, not only to know better the behavior of the SFCL, but also to show clarity to the aspect put forward before.

Proposed Host TA Infrastructure/Installation – Justification (about one page)

Specify the type of TA infrastructure (e.g. distributed generation simulator; domotic house; etc.) and if possible which one of the 13 TA Infrastructures in DERri may better serve the scope of the proposed research. Justifications should be provided on the grounds of the test set-up, testing method, equipment, past experience in relevant subject, etc. State whether the TA User team intends to deliver to the premises of the TA Infrastructure parts or components to be tested at the TA User's expense and responsibility, or to cover the whole or part of the construction/adaptation cost of the specimens to be tested.

First and foremost, RSE Italy, according they report are the only ones who have a SFCL. Moreover they add other system capable to do very interesting test.

Second, Ustrat UK, because they are based on protective facilities.

Last, KEMA, because I know they have been working in SFCL.

Synergy with ongoing research (about ½ page)

Provide information on any concurrent research project with the same or similar subject with the one proposed. Describe the synergy (if any) that will be sought between the existing and the proposed project.

No found.

Dissemination – Exploitation of results (about ½ page)

Describe the means through which the results to be obtained from the proposed project will be diffused and made broadly known.

One of the goals of the project is to issue the result as a report to someone of the most important magazines inside the scientific community, as a part of being the kick-off of a major investigation during the following three years approximately.

Examples of the magazines:

IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY
IEEE Transactions on Dielectrics and Electrical Insulation
IEEE TRANSACTIONS ON MAGNETICS,

IEEE TRANSACTIONS ON POWER DELIVERY,
Electrical engineering, etc.

Time schedule (about ½ page)

Provide an indicative time-schedule for the proposed work and a target starting date.

As spoken with RSE the best date will be in the beginning of the following year, which I agree. If another entity is interested I would like to keep the same date.

Proposed date: 4 February 2013. 1 month length.

Description of the proposing team (as long as needed)

Give a short description of each member (organization and persons) of the proposing team including publications, experience in test campaigns and role in the proposed project.

One-person team. No publications yet, hopefully this experience will be my first one. Wide experience in test facilities, having been working at Carlos III University in two grants, two-month and one academic year long.

I have been working as an Engineer since the beginning of 2005, basically in the electrical infrastructure of the Railway sector.

Last year I finished a Master in Electronic and Electrical Engineering at UNED.I have got many courses and seminars related to electricity.