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ON THE ESTABLISHMENT OF NATIONAL NDT RESEARCH CENTER IN SAUDI ARABIA

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ABSTRACT

This paper presents the strategic plan of the emerging Saudi National Center for Non-Destructive Testing SaNC_NDT. The center is established to support synergetic and interactive programs in research, industrial collaboration, and technology transfer in the field of NDT. The mission, vision, and objectives of this center are introduced along with measures taken to assure the success in achieving planned objectives.

Center organization is presented, illustrating the administration as well as the four main divisions: Community Services; Research & Development; Facilities; Human & Financial Resources. The management body of the center is addressed including the Steering Board, the Center Council, and the Advisory Committee. Facilities required to run the center are described and the planned training program designed for center staff of engineers and scientists. The excepted role of SaNC-NDT in the Saudi industry is outlined as well as expected affiliations with national and international organizations. This paper, in the belief of the authors, presents a template for initiatives in countries that are interested in establishing equivalent NDT centers.

1. INTRODUCTION

Established in 2007, at King Abdulaziz City for Science and Technology (KACST), The *Saudi National Center for Non-Destructive Testing* (SaNC-NDT), has emerged as a pioneer center in Saudi Arabia, dedicated to steering the scientific research and industrial application of nondestructive testing and evaluation. The center comes while the world witnesses increase in competition and move towards globalization. Interest in quality control measures has thus risen worldwide and the lead was taken by KACST to establishing the SaNC-NDT for assuring competitiveness and quality of Saudi industry.

SaNC-NDT will support long-term NDT research and development leading to potential impact in fields such as geophysics, aerospace industry, civil constructions, petrochemical industry, machinery, and biomedical and biological arena. This center also addresses development of a balanced infrastructure, novel approaches to the education and training, and rapid transfer of knowledge and technology gained from the research and development efforts.

2. KACST LEADERSHIP AND ROLE

SaNC-NDT is the most recent offspring of King Abdulaziz City for Science and Technology (KACST) [KACST]. The emergence of the center assures the continuous role of KACST in promoting research, and adopting and devising new technology for the national

interest of the Kingdom. KACST is an independent scientific organization, established by Royal Decree in 1977 under the name of Saudi Arabian National Center for Science and Technology (SANCST) and later in 1985 renamed as King Abdulaziz City for Science and Technology (KACST). A Supreme Committee chaired by the Prime Minister governs KACST. The Committee includes the ministers of the major ministries to which science and technology are of greatest relevance.

3. CENTER VISION

The vision of the National Center for Nondestructive Testing is to be the leading center in the region in developing and promoting the profession and technologies of nondestructive testing and evaluation.

4. CENTER MISSION

The mission of the National Center for Nondestructive Testing is to advance the science of NDT on the individual and industrial level, to create an environment that encourages innovation and creativeness in NDT technologies, and to achieve prominence and recognition at the regional level.

5. CENTER OBJECTIVES

In order to achieve the vision of the center, the following objectives are to be fulfilled:

- Create a university-industry collaboration umbrella in the field of NDT research.
- Support national acceptance and use of the center services.
- Encourage and sponsor local scientific talents, and attract their attentions to the field of NDT.
- Develop and design equipment for specific NDT tasks.
- Deal with industrial challenges related to NDT, taking into account the environmental as well as societal aspects of the region.
- Transfer technology and update awareness of advances in NDT.
- Advocate and provide NDT personnel certification by preparing and organizing training courses.
- Encourage local industries to implement NDT methods in product quality control and improvement of manufacturing process.
- Organize periodic conferences and workshops to explore the aspects of NDT.
- Represent the kingdom in the World Federation for Nondestructive Evaluation Centers (WFNDEC) founded in 1998, [WFNDEC].
- Promote and strengthen relations with national and international NDT societies, centers, and organizations.
- Achieve self-finance as a long-term goal.

6. EXAMPLES OF CENTER TASKS

In order to advance the vision of a strong long-term research and technological base, the key opportunity for the interested parties in NDT will be through collaborative research and/or support of the center for activities within KACST and other organizations such as universities. Some representative activities are outlined below:

- Identification of potentially attractive areas for collaborative research to be discussed in more details by the Steering Board.
- Exchanges and seminars.
- Sponsorship of professorial chairs, training, and support for researchers.
- Support and cooperation for initiatives to broaden the awareness of technology and science and related careers within the Kingdom
- Grant undergraduate and graduate students, scholarships as well as coop programs.

Finally, where Saudi institutions have unique technological expertise, the center, and its sponsors can utilize their presence and connections to promote broader international recognition and utilization of this expertise.

7. DELIVERABLES

An annual report that includes all of the performed activities of the center will be delivered to its sponsors, and will be available to the public and interested parties. The main deliverables of the center: results and reports obtained from research projects; software developed by the center, and publications related to organized meetings, workshops or conferences.

8. CENTER ORGANIZATION

In addition to the administration body, it has the following main divisions:

1- Community Services Division

2- Research & Development Division

3- Facilities Division

4- Human and Financial Resources Division

Details of center organization are given next.

8.1. CENTER ADMINISTRATION

Activities within the SaNC-NDT are guided by a Steering Board (SB), and the Chairman of this board is KACST vice-president. The center is run by Center Council (CC) with the help of Advising Committee (AC).

8.1.1. Steering Board (SB)

The SB seeks to create and maintain an environment that encourages basic and applied research to develop new knowledge in the field of NDT. The SB also seeks to nurture an institution that is ever responsive to the needs of the dynamic and complex industry, by developing and offering programs of public services.

The SB delegates responsibility to the center director and through the director to officers and departments. The SB is composed of representatives from industry, governmental agencies, as well as KACST. Members will be selected to represent leading companies in the Kingdom such as Aramco, Sabic, Saudi Airlines, as well as military representing personnel.

Technical subcommittees in support of the Steering Board may also be established to provide in-depth forum for discussion of specific research projects. The steering board would guide technical subcommittees to promote technical interchange between the sponsors and center research directions. The main roles of the SB are outlined as follows:

- Adopting regulations to achieve center objectives and insure that the conduct of its affairs will be in accordance with the highest academic standards.
- Review of the overall strategic plan.
- Review and prioritization research categories.
- Prepare annual funding recommendations.
- Conduct periodic meetings to review progress and address any issues that have arisen.
- Nominate and assign experts in the advisory committee.

8.1.2. Center Council (CC)

The CC meets at least on a monthly basis to assure that the daily running of the center is in accordance with its vision, mission, and objectives. The CC is authorized to prepare the budget, approve the expenditures and make planning and coordination for the activities conducted by the center. The CC includes members who are both inside (executive) directors as well as outside (non-executive) directors.

8.1.3. Advisory Committee (AC)

The advisory committee is chosen from experts in nondestructive testing in different bodies and agencies in the Kingdom. This includes universities, research institutes, governmental agencies, industry, as well as public work agencies. Members of the committee work on partial time basis to help direct the center research to the industry benefit, and also to add to the recent advances in the field of NDT worldwide.

8.2. COMMUNITY SERVICES DIVISION

This sector consists of the following departments:

1- Training Department
2- Consultation Department
3- Public Relations Department
4- Certifications Department

Each of these departments is described next.

8.2.1. NDT Training Department

This department works on establishment of a training program for NDT. At the beginning of establishment of the NDT center, the department will cooperate with industry to set up the program according to their needs. The trainers will be from the center as well as cooperating personnel from other national and international institutes and industries. Once the training program is planned for the center employees, there will be level III employees at SaNC-NDT who will conduct the offered training programs.

8.2.2. Consultation Department

The service department prepares various technical teams to deal with on-site inspection trips to different industrial facilities in the Kingdom. The teams make use of the mobile lab in their operations. The operation in this department is done in cooperation with different departments in the R&D division.

8.2.3. Public Relations Department

The main goals of this department are to:

- Keep contacts with various industry sectors.
- Update a database with center capabilities and publicize this information with different modes including a website.
- Develop a database of industry challenges related to NDT.
- Convey the NDT activities and research outcomes of the center to the public through media including newspapers, TV programs, brochures, website, etc.

8.2.4. Certification Department

This department assures the application of center regulations related to the accreditation of trainees. The department also cooperates with other international agencies to establish a certification program for levels I, II and III for Saudi industry. The certification department will organize written as well as practical exams in all common NDT techniques, and will supervise the accreditation of trainees who pass the required exams.

8.3. RESEARCH AND DEVELOPMENT DIVISION

The R&D sector plays a major role in achieving the objectives of the center. The sector is comprised of the following branches: Technical Departments, NDT Modalities Research Groups; Application Based Research Groups; Publications and Conferencing. Each of these branches is discussed next.

8.3.1. Technical Departments

The technical departments are set to agree with the scientific specialties of the employees. This is to assure the homogeneity of the background of employees working in the same department. There are four departments as follows:

1- Civil Engineering Department

2- Electrical Engineering Department

3- Mechanical Engineering Department

4- Science Department: physicists, chemists and geophysicists

8.3.2. NDT Modalities Research Groups

Taking into consideration the multidisciplinary nature of the field of NDT, research groups are formed from different departments to work together on one NDT modality. Brief outline of each department is presented next.

A. Acoustic & Ultrasonic Research Group

This group is concerned with application of acoustic type waves. Techniques of interest to this group are acoustic emission methods and ultrasonic methods.

B. Electromagnetic Research Group

This group is concerned with NDT systems that depend on electromagnetic (EM) fields in NDT inspection. The group, however, is concerned with the EM spectrum starting from DC up to the microwave range. IR, optical and ionizing radiation ranges of the spectrum are covered in other research groups.

C. Radiography Research Group

This group focuses on various types of ionizing radiation including x-ray and gamma ray in NDT applications.

D. Visual & Optical Research Group

The focus of research in this group is toward the implementation of optical range of the spectrum in NDT applications. Examples include optical inspection, liquid penetrant inspection, as well as thermography.

8.3.3. Application-Based Research Groups

In additions to groups working on each of the NDT modalities, there will be groups working on application-oriented research. The objective is to develop techniques based on one or more of NDT techniques for certain applications. The followings are five such groups as shown next.

A. Geophysics Research Group

Applications of interest to this group include geophysical exploration, soil characterization, and mining. Microwave modality is the main method in this field of research.

B. Aerospace Research Group

This group directs its research to aircraft inspection to identify corrosion and fatigue cracks. It also deals with satellite structures testing to identify faults and cracks in metals, composites, and plastics and to verify welding quality for some components in the satellite. Various modalities are of interest to this group including radiography, ultrasonics and eddy current testing.

C. Civil Structures Research Group

This group focuses of inspection of civil structures, which are mainly made of concrete, masonry, and steel. New NDT techniques are invoked in this developing field of research.

D. Oil Industry Research Group

This group focuses on research directed to applications in the oil industry such as testing storage tanks and pipelines. Various modalities are invoked in these applications.

E. Power Plants Research Group

Applications of this research include inspection of rotating machinery in power plants, turbines, compressors, and pumps.

8.3.4. Research Funding Department

This department is responsible for performing studies of concurrent as well as future forecasts of national needs of research in NDT. According to these studies, plans are prepared of suggested topics for the annual research program to be submitted to the Steering Board for final approval, before announcement to the research community in the Kingdom.

8.4. FACILITIES DIVISION

The facilities sector includes the following departments:

1- Calibration Laboratory Department

2- Specialized Laboratories Department

3- Information Center

Details of this division are given next.

8.4.1. Calibration Laboratory Department

Calibration lab provides periodic and more thorough inspection of instrumentation performance, usually for assuring accuracy and precision specifications. Calibration is required by international standards, and a system of periodic calibration and maintenance must exist for any facility carrying out nondestructive testing. Failure to calibrate NDT equipment represents a safety risk and a risk to the integrity and credibility of those institutions that choose to ignore this requirement. The calibration lab will include the following items:

1- Standard samples of various materials and calibration blocks.

2- Flawed samples with identified defects that are used to test the NDT equipment.

3- High quality equipment, which are used to calibrate the field instruments.

Periodic calibration is essential for nondestructive testing systems [Hoolihan, 1999]. The manufacturers generally recommend maintenance periodically. The use of NDT instruments for testing without periodic calibration would increase with time the uncertainty of the measurements. Such behavior is associated with drift in component performance. These components could fail gracefully, i.e. without disabling the instrument, and create unexpected behavior. Problems that arise in typical NDT techniques neglecting calibration are explained in [Sun, 1998].

8.4.2. Specialized Laboratories Department

The main labs in this department are: Ultrasonic Inspection Laboratory; Acoustic Emission Inspection Laboratory; Eddy Current Inspection Laboratory; Magnetic Field Inspection Laboratory; Magnetic Particle Inspection Laboratory; X-ray Inspection Laboratory; Thermography Inspection laboratory; Visual Inspection laboratory; Mechanical Inspection Laboratory; Computing Services Laboratory; Machine Shop; Electrical and Electronic Shop; Mobile Laboratory.

The mobile laboratory consists of a vehicle equipped with portable NDT inspection systems and wireless GPRS computer network to allow access to the center database. The lab can be moved to any place in the Kingdom to perform site testing.

8.4.3. Information Center

The Information Center includes the Central Library as well as electronic database management office. The center achieves one of the strategic objectives of the NDT center to be a premier provider of NDT/NDE information including publications, references, archives, and training. The library collection will include: NDT textbooks and conference proceedings, NDT research and association journals, specialized collection of subject catalogs, and indexes as well as computer databases.

8.5. HUMAN AND FINANCIAL RESOURCES DIVISION

The Human and Financial Resources division is concerned with the different aspects of advancing the resources of SaNC-NDT. It consists of the following departments:

1- Recruiting Department

2- Budget & Financial Department

3- Legal Department

4- Training & Technology Transfer Department

Success of the center is based upon robust programs for enhancing human resources. Technology transfer programs are prepared by the center in collaboration with international companies in the field of NDT. The department is responsible of training program of Center employees. A budget plan is prepared to cover the expenses of various training programs. The duration of such projects can extend as long as 24 months.
The training programs meet and exceed the requirements established in SNT-TC-1A guidelines and recommendations for NDT testing. NDT personnel are generally certified to several different levels of competence within each of the NDT methods. The levels are Level I, Level II, and Level III. The approach used to assure that NDT personnel possess the qualifications necessary to do proficient work includes:

- Training to gain the necessary knowledge
- Experience under the guidance of specialists in the field
- Qualification examinations to verify that competency has been realized.
- Certification to document successful demonstration of competency

9. EXPECTED ROLE OF SaNC-NDT

With the resources planned for SaNC-NDT, the center would have the potential for introducing innovative NDT industrial solutions. With time, the center will integrate itself in Saudi industry. It will also have essential role in being a focal industrial point that connects a large group of national and international institutes, organizations, and associations. The different aspects of the center interactions include:

A. Education

SaNC-NDT would collaborate with educational institutes in the Kingdom to enhance awareness of NDT applications at all levels from high school to universities. This is in direct response to the Ministry of Higher Education objective of instituting programs designed to improve the quality, distribution, and effectiveness of the Nation's human resource base. Collaborations with community colleges would provide improved training programs. Work will be done closely with colleges of engineering and science at both undergraduate and graduate levels.

B. Research

Scientists at the center would interact with the research community in the Kingdom as well as with other centers for NDT around the world to achieve the following goals:

- Conduct and support research and technology.
- Enhance technology for current NDT instrumentation.
- Introduce new applications that would benefit from newly developed systems.

C. Industry Interaction

The center would interact with industry in the Kingdom as well as international industry in integrating NDT techniques into industry at different phases including design, manufacturing, and operational phase. A highly effective set of programs for industrial outreach and knowledge transfer are envisioned:

- Attract industrial collaboration to secure the center support and funding which is critical to the long-term institutionalization of the center's science and engineering programs.
- Work with industry as solution provider for short-term research project.
- Facilitate the development of new technologies resulting from center-university-industry research partnerships through promotion, administrative support, and initiation of new relationships.
- Optimize the flow of research results from the center to industry and government.

D. Knowledge Transfer

One of the main objectives of the center is to enhance the transfer of technology and to have the *know-how* ability and that can be attained by:

- Supporting and promoting interdisciplinary research activities and accomplishments.
- Impacting positively, the community's orientation to science and technology.
- Initiating a systematic approach to stimulating intellectual exchange, and collaboration between the center's researchers and relevant scientific and technical researchers in the public and private sectors.

E. Standardization

The center will work with standardization bodies in the Kingdom, particularly the Saudi Arabian Standards Organization as well as international organization bodies to formulate safety standards for applications of interest to the Kingdom.

10. CONCLUSIONS

With the provision of more than 100 million Saudi Riyals to establish SaNC-NDT, KACST continues to play its role in adapting science and technology as a means of modernizing the Saudi society. The estimated cost covers construction, equipment, training, and salaries. SaNC-NDT would have various interaction aspects with the society, including industrial impact, research effects, and educational enhancement. The center will serve as a resource for those

seeking assistance with current NDT/NDE problems, provide a foundation for defining and solving the next generation of problems, and train the people who will enable companies to create their own solutions.

The center, therefore, extends beyond academic research and training to encompass a framework for communication and partnership. It comes as a new identity that uses the synergy of its constituents to provide a unique experience to the nation. SaNC-NDT would also be a new character to various communities in the Kingdom including industry, research, as well as consumers. SaNC-NDT would provide an outstanding opportunity to achieve the foundation of providing a competitive Saudi industry in the age of globalization, in which only strong industry has a chance of survival.

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