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NUCLEAR-RELATED AGREEMENTS AND COOPERATION IN SOUTH ASIA

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INTRODUCTION

The aim of this paper is to understand the numerous nuclear-related[2] agreements that involve India and Pakistan, and in so doing identify starting points for future confidence-creating and confidence-building projects. Existing nuclear-related agreements provide a framework under which various projects can be proposed that foster greater nuclear transparency and cooperation in South Asia. The basic assumptions and arguments underlying this paper can be summarized as follows:

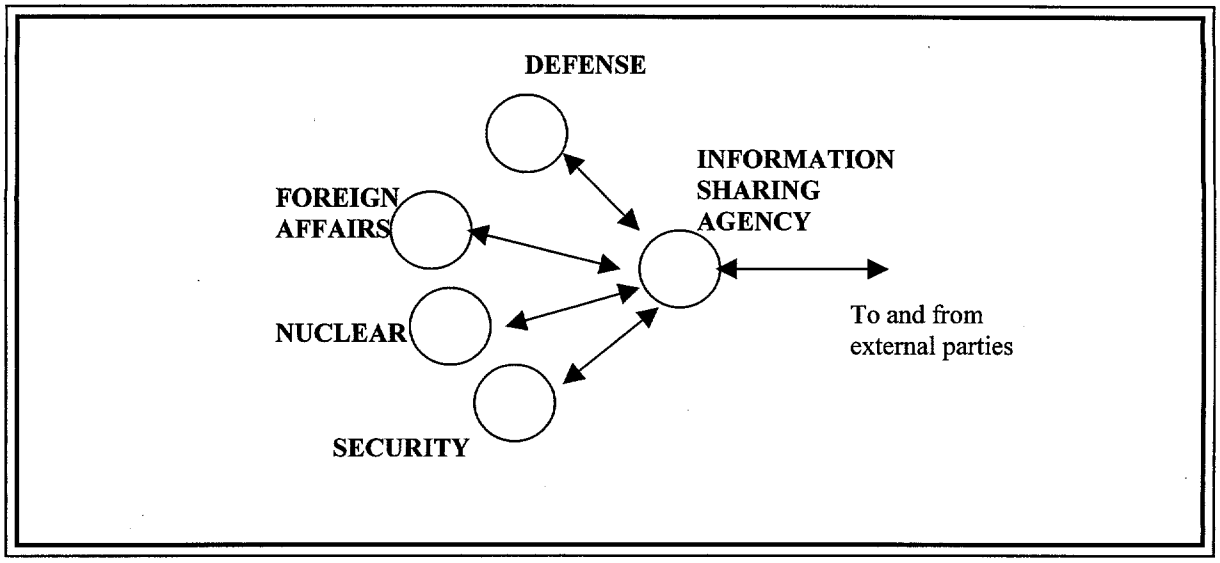
- Increased nuclear transparency between India and Pakistan is a worthwhile objective, as it will lead to the irreversibility of extant nuclear agreements, the prospects of future agreements; and the balance of opacity and transparency required for stability in times of crises.
- Given the current state of Indian and Pakistani relations, incremental progress in increased nuclear transparency is the most likely future outcome
- Incremental progress can be achieved by enhancing the information exchange required by existing nuclear-related agreements.

Therefore,

- A survey of the reporting requirements of existing nuclear-related agreements involving India and Pakistan is needed.
- Based on this survey a series of projects can be proposed that incrementally enhance the sensitivity of nuclear-related information being shared between India and Pakistan.

A further recommendation of the paper is that the governments of India and Pakistan work towards creating mutually understood nuclear information management infrastructures in the form of agencies made up of personnel from and with links to the defense, foreign affairs and nuclear ministries and other security agencies. These agencies, tasked with facilitating the sharing of nuclear information, could avoid duplication of effort and mistakes in determining degrees of allowable transparency. Figure 1 describes how such a system of nuclear information sharing could function.

Figure 1: A system of information sharing using a nodal agency



The majority of this paper's effort is focused on India and Pakistan, as these are the two South Asian[3] countries most involved in nuclear energy and the only ones actively pursuing nuclear weapons development. Table 1 lists select nuclear research institutes and facilities in South Asia. A role for Bangladesh and Sri Lanka (the two other South Asian countries involved in nuclear programs) is discussed primarily in the context of an existing arrangement of the International Atomic Energy Agency (IAEA) for regional cooperation in Asia. The primary reason for beginning Indian and Pakistani nuclear transparency issues in a multilateral South Asian context is that such projects would have the possibility of continuance even if there were an increase in Indian and Pakistani tensions. Bilateral Indian and Pakistani nuclear transparency projects easily stall in the circumstances of heightened tensions.

An expansion of existing Indian and Pakistani arrangements that require the sharing of nuclear information with international, regional and bilateral entities can initiate a process of greater nuclear transparency between India and Pakistan and in South Asia. Elbaradei, Nwogugu and Rames of the IAEA provide an excellent overview of the international legal framework that governs nuclear energy. [4] Using their description as a guide, the Indian and Pakistani relationships to the many treaties, conventions and codes of practice that form the international legal framework governing nuclear matters are discussed. A discussion of Indian, Pakistani and South Asian bilateral, regional, and international nuclear-related agreements not available in the paper by Elbaradei, Nwogugu and Rames is also provided.[5] Finally, some ideas for using the reporting requirements of existing nuclear agreements to increase nuclear transparency in South Asia are presented.

Table 1: Select Nuclear Research Institutes and Facilities in South Asia. (Note: Not a complete but an illustrative list.)

COUNTRY	TYPE OF FACILITY	NAME, LOCATION AND WEB ADDRESS (WHERE AVAILABLE)
Bangladesh	Nuclear Research Institute	Bangladesh Atomic Energy Research Establishment, Institute of Nuclear Science and Technology, Savar (near Dhaka)
India	Nuclear Research Institute	Bhabha Atomic Research Centre, Mumbai Web Address: http://www.barc.ernet.in Indira Gandhi Center for Atomic Research, Kalpakkam Web Address: http://www.igcar.ernet.in
	Nuclear Plant Operator/ Owner of Groups of Facilities	Nuclear Power Corporation of India Ltd., numerous locations in India Web Address: http://www.npcil.org
Pakistan	Nuclear Research Institute	Pakistan Institute of Nuclear Science and Technology, Islamabad and Nilore A.Q. Khan Research Laboratories, Kahuta Web Address: http://www.krl.com.pk/
	Nuclear Plant Operator/ Owner of Groups of Facilities	Pakistan Atomic Energy Commission, Karachi Nuclear Power Plant, Karachi, Chashma Nuclear Power Plant, Mianwali
Sri Lanka	Nuclear Research Institute	Sri Lanka Atomic Energy Authority, Colombo

The PACATOM project of the Council for Security Cooperation in the Asia Pacific (CSCAP) provides a useful precedent to the subject of increasing nuclear transparency in South Asia. CSCAP is a non-governmental organization linking research institutes and security specialists within the Asia Pacific community. Through its international Working Group on Confidence and Security Building Measures (CSBM), CSCAP is "examining the possibility of defining and promoting an international Asian or Pacific Atomic Energy Community (PACATOM)".[6]. The PACATOM project recognizes that the creation of a formal PACATOM institution is premature, and is therefore currently focused on promoting confidence and increasing transparency in the region. The CSBM Working Group has identified six areas of nuclear cooperation: Safety Cooperation; Energy Cooperation; Research Cooperation; Regional Safeguards; Managing the Front End of the Nuclear Fuel Cycle; and, Managing the Back End of the Nuclear Fuel Cycle. From the Working Group's perspective, two of these six areas have been identified as being best suited for multilateral cooperation. "One is safety cooperation; the other is cooperation in managing the back end of the fuel cycle". In the case of India and Pakistan, too, all of these areas of potential nuclear cooperation seem well suited for further exploration.

Safety cooperation is already occurring between India and Pakistan to some extent through the Regional Co-operative Agreement for Research, Development and Training in Nuclear Science and Technology in Asia and the Pacific (RCA) developed by the IAEA for the Asia region. The RCA has been in existence for over twenty-five years. In 1998, within the framework of the RCA, China, India, the Republic of Korea and Pakistan, collaboratively developed the "Regional Asia Reference Book on Good Operational Safety Management" of nuclear power plants[7].

In recent years, regional energy cooperation within South Asia is receiving increased attention. An example of such cooperation is the South Asia Forum for Infrastructure Regulation (SAFIR) being currently administered by the Tata Energy Research Institute (TERI) in New Delhi, India. "Covering Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka, SAFIR is designed to assist in the building of regulatory capacity in the electricity, natural gas, telecommunications, water, and transport sectors"[8]. Other energy cooperation measures receiving great attention include the sale of electrical power and oil and gas among South Asian countries[9].

The areas of regional research cooperation, safeguards, and managing the front and back end of the nuclear fuel cycle are much more contentious, and not so open for collaboration. Back end issues such as reprocessing and storage of spent fuel are probably the most contentious and sensitive nuclear related issues. From the viewpoint of increasing nuclear transparency related to warheads and fissile materials, these are the very issues that need most careful attention. In these contentious areas, incremental progress is the most plausible optimistic short-term future scenario.

Steve Fetter has made a valuable observation that "unlike past arms control agreements, which were discrete events, we should think of increased [nuclear] transparency as a continuous process, in which we constantly increase the exchange of more detailed information and find ways to corroborate that information."[10] The Tokyo Forum,[11] a high-level group of disarmament experts and policy-makers (serving in their individual capacities) has recently issued a report calling for increased nuclear transparency[12]. In the context of India and Pakistan, nuclear transparency can only be increased incrementally, using existing agreements to foster a process of nuclear information exchange. Viewed as a continuous process of increasing sensitivity, any increase in nuclear transparency becomes of value, as it forms a part of a chain of cooperative acts. Increased transparency increases the irreversibility of arms control agreements.

A state of low intensity war exists between India and Pakistan, characterized by cross-border shelling and exchanges of gunfire as a daily occurrence. Therefore, proposing steps for increased nuclear transparency between these countries could easily seem futile to the casual observer. However, the Indian and Pakistani relationship is complex and works at many levels. The complexity of the Indian and Pakistani relationship provides glimmers of hope that progress can occur in some areas of interaction even while there are major setbacks in others. For instance, in the summer of 1999, military conflict in the Kargil area of Kashmir intensified into a limited war involving a significant loss of lives, massive artillery battles and the use and loss of Indian fighter aircraft. A few days after

this conflict had begun to intensify, the News Network International reported from Islamabad on June 1, 1999, that the Federation of Pakistani Chambers of Commerce and Industry had called for a relaxation of curbs on machinery imports from India[13]. The Chamber noted in its proposals for the 1999-2000 trade policy that Pakistani manufacturers often import machinery from distant countries, paying more and waiting a far longer time for delivery than if orders had been placed in India. Another glimmer of hope for progress in nuclear transparency is evident in the fact that in 1998, despite animosities being worsened by reciprocal nuclear weapons tests, Indian and Pakistani representatives worked collaboratively on nuclear safety issues within the RCA framework of the IAEA. Historically, many Indian and Pakistani cooperative agreements have been actively pursued and have survived the tumultuous course of the past five decades.

Assessing the reporting requirements of existing nuclear agreements provides an opportunity to suggest incremental advances in the sensitivity and detail of the information being reported. Studying the Indian and Pakistani relationship to nuclear agreements other than the major nuclear non-proliferation treaties, such as the Comprehensive Test Ban Treaty (CTBT) and the Non-Proliferation Treaty (NPT), also helps in identifying a wider range of policy options for moving these countries towards greater nuclear transparency. For example, the Convention on Nuclear Safety (CNS) has been signed and ratified by Pakistan, but only signed and not ratified by India. The process of building greater consensus within India for signing the CTBT could begin with the international community urging India to ratify the less problematic CNS as a confidence building step towards the future ratification of more contentious treaties. When India and Pakistan are both parties to the CNS they could initiate a bilateral process of sharing the safety reports that the CNS requires. There are other nuclear-related agreements similar to the CNS that India has signed and ratified, but Pakistan has not. These agreements offer options for nudging Pakistan towards greater nuclear transparency with India.

NUCLEAR-RELATED AGREEMENTS

The agreements discussed in this paper are those that have been signed and ratified, simply signed, or acceded to in some measure by India or Pakistan. International conventions that have neither been signed nor ratified are not discussed. To suggest nuclear transparency measures for agreements and conventions not yet acceded to by either India or Pakistan, such as the Nuclear Non-proliferation Treaty (NPT), the Comprehensive Test Ban Treaty (CTBT) and the Fissile Materials Cut-off Treaty (FMCT) (that is in negotiation)[14], is far more problematic than to consider measures that strengthen existing arrangements. To the extent possible, however, proposals for increased transparency should try to anticipate some of the requirements of future treaties, and attempt to foster conditions promoting Indian and Pakistani signature and ratification of the NPT, the CTBT and (in the future) the FMCT.

Table 2 lists the nuclear-related agreements (in alphabetical order) involving India and Pakistan and the dates of signature and accession (if applicable).[15] The following sections discuss many of these agreements in terms of their reporting requirements and the framework they provide for India and Pakistan to share nuclear information.

TABLE 2: Nuclear-related Agreements Involving India or Pakistan (in alphabetical order)

Treaty/ Convention/ Agreement	India		Pakistan	
	Date of Signature	**Date of Accession**	**Date of Signature**	**Date of Accession**
Agreement on the Prohibition of Attack Against Nuclear Installations and Facilities	12/31/1988	1/ 1/1991	12/31/1988	1/1/1991
The Antarctic Treaty		8/19/1983		
Code of Practice on the International Transboundary Movement of Radioactive Waste		9/21/1990		9/21/1990
Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	9/29/1986	2/28/1988		10/12/1989
Convention Concerning the Protection of Workers Against Ionizing Radiation		11/17/1976		
Convention on Early Notification of a Nuclear Accident	9/26/1986	2/28/1988		10/12/1989
Convention on the Liability of Operators of Nuclear Ships	5/25/1962	Not applicable – not in force		
Convention on Nuclear Safety	9/20/1994		9/20/1994	9/30/1997
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter				4/8/1995
Food and Agriculture Organization/ United Nations – nuclear projects[16]		10/1964		10/1964
Lahore Memorandum of Understanding	2/21/1999		2/21/1999	
International Convention for the Safety of Life at Sea		6/16/1976		4/10/1985
Regional Co-operative Agreement for Research, Development and Training in Nuclear Science and Technology in Asia and the Pacific	6/7/1972	6/7/1972	9/6/1974	9/6/1974
Safeguards Agreements with the IAEA[17]		Various times		Various times
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies	3/3/1967	1/18/1982	9/12/1967	4/8/1968
Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water	8/8/1963	10/10/1963	7/14/1963	3/3/1988
Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof		7/20/1973		
United Nations Convention on the Law of the Sea	12/10/1982	7/29/1995	12/10/1982	

Bilateral Agreement on the Prohibition of Attack against Nuclear Installations and Facilities

The bilateral Agreement on the Prohibition of Attack against Nuclear Installations and Facilities (the No-Attack agreement) prohibits attack, directly or indirectly, against nuclear installations or facilities in either country. This agreement is a unique bilateral agreement that no other hostile countries have yet emulated. It expands - in a sense - the scope of Articles 56 and 15 of the first and second protocols to the Geneva Convention. These articles state that - "Works or installations containing dangerous forces, namely dams, dykes and nuclear electrical generating stations, shall not be made the object of attack, even where these objects are military objectives, if such attack may cause the release of dangerous forces and consequent severe losses among the civilian population."

The scope of the Indian and Pakistani No-attack agreement is much broader than the Geneva Convention's prohibition against nuclear electrical generating stations. Nuclear installation or facilities against which attack is prohibited are defined in the Indian and Pakistani agreement to include "nuclear power and research reactors, fuel fabrication, uranium enrichment, isotopes separation and reprocessing facilities as well as any other installations with fresh or irradiated nuclear fuel and materials in any form and establishments storing significant quantities of radioactive materials".

On January 1 of each calendar year, each country provides the other with a list of the latitude and longitude of its nuclear installations and facilities. In the past, proposals have been made by India to extend the list to include population centers and targets of economic value. These are counter-value targets, as opposed to counter-force targets such as missile silos, air bases and nuclear weapons production facilities. However, the recent draft nuclear doctrine of India involves a deterrent capability based on unacceptable damage to an opponent. Given this doctrine, the likelihood of expanding the No-Attack agreement to include counter-value targets may now be small. There are other benefits to sharing this list. The existence of the officially exchanged list creates an excellent framework for nuclear information sharing.

From an information sharing perspective the list forms an excellent common basis of a geo-spatially-referenced database. This database could provide the backbone of an Indian and Pakistani nuclear information sharing process. Implicit in the exchange of a list of the latitudes and longitudes of their nuclear facilities is the recognition that each party will gather satellite imagery of the sites. To increase the transparency and information value of the list exchange, the two sides could begin to share some ground truth data from each facility that would enable each side to better analyze and track changes at the facilities.

The list could be used to create a cooperative database that scientists from each side would access. Only public information would be supplied. However, the act of linking publicly available information into a cooperative database referenced to an officially exchanged list will strengthen norms for bilateral nuclear data exchange that currently are extremely weak.

The Issue of Pre-emptive Strikes

The No-Attack Agreement has relevance to the issue of pre-emptive strikes. Many authors have recognized that a small nuclear force has to contend with the issues of survivability and delegated control[18]. To survive a pre-emptive strike, the force must be dispersed. Dispersal requires delegation of control over the nuclear forces leading to an increased risk of inadvertent use in a crisis. The No-Attack Agreement, in a sense, helps resolve this dilemma. The Agreement has created safe locations for India and Pakistan to store nuclear weapons, and thus reduces the fears of pre-emptive strikes if storage of weapons is done at locations only from among the declared facilities. This reduction in fears of a pre-emptive strike allows more assertive control of the dispersed nuclear force. The No-Attack Agreement also limits the choices of safe storage locations, creating an incentive to avoid forward deployment of nuclear weapons.

India has unilaterally declared its intentions to the No-First Use of nuclear weapons. Pakistan has yet to issue a similar declaration, and, based on its smaller conventional defense, may never do so. No-First Use implies negating the escalation of a conventional conflict to a nuclear exchange. Pre-emptive strikes are aimed at destroying the nuclear retaliatory capabilities of the adversary, and are a sub-set of First Use options. Without progressing to a No-First Use treaty, that is likely to be difficult to accomplish in the short-term, the two countries could negotiate a treaty on no pre-emptive strikes. Such a treaty could be based on formally limiting the choice of weapons storage locations. These locations would be from among those in the annual list of protected facilities exchanged as a part of the No-Attack Agreement.

Article 8.5 of the draft Indian nuclear doctrine states that –

> *In view of the very high destructive potential of nuclear weapons, appropriate nuclear risk reduction and confidence building measures shall be sought, negotiated and maintained.*

Given this stated commitment, a treaty that helps reduce the fears of pre-emptive strikes could be an excellent stabilizing measure for India to propose to Pakistan. The No-Attack Agreement provides the basis for beginning a dialogue in this direction.[19]

The Lahore Memorandum of Understanding

On 21 February 1999, in Lahore, Pakistan, the Foreign Secretaries of India and Pakistan signed a MoU that calls for nuclear-related measures. One of these seeks to prevent accidental or unauthorized use of nuclear weapons. Another calls for the creation of communication mechanisms similar in some aspects to those required by the Convention on Early Notification of a Nuclear Accident. Among its several points, the Lahore MoU states that –

The two sides are fully committed to undertaking national measures to reducing the risks of accidental or unauthorized use of nuclear weapons under their respective control. The

two sides further undertake to notify each other immediately in the event of any accidental, unauthorized or unexplained incident that could create the risk of a fallout with adverse consequences for both sides, or an outbreak of a nuclear war between the two countries, as well as to adopt measures aimed at diminishing the possibility of such actions, or such incidents being misinterpreted by the other. The two sides shall identify/establish the appropriate communication mechanism for this purpose.

The range of nuclear installations covered by the proposed bilateral agreement will be greater than that covered by the existing international Convention on Early Notification of a Nuclear Accident (restricted to non-weapons facilities); and presumably will cover the facilities listed in the "No-attack" agreement. The Convention on Early Notification of a Nuclear Accident provides a guide to the eventual form of a future Indian and Pakistani bilateral agreement. The bilateral agreement is also envisaged as diminishing the possibility of misinterpretation of data. The scope of the bilateral agreement, therefore, unlike the international Convention, raises the possibility of baseline radiological release data being shared on a regular basis. Such data could also include other supporting data such as climatic data (wind, precipitation, etc.) required for radiological release modeling, so as to allow better interpretation of any readings above normal.

Limiting the Areas of Deployment of Nuclear Weapons in South Asia

Pakistan has, for several years, proposed the idea of a South Asian Nuclear Weapons Free Zone (SANWFZ) that India has not accepted. India has, however, supported the concept of the Indian Ocean as a Zone of Peace (IOZP). Such a zone is proposed to restrict nuclear weapons in the Indian Ocean. Combining some aspects of each of these proposals, a stabilizing measure for India and Pakistan to consider could involve first pledging to restrict nuclear weapons deployment from the western and northern Indian Ocean and their coastal areas. This first phase is a compromise of the SANWFZ and the IOZP ideas. It would also limit Indian plans to deploy nuclear-tipped missiles on submarines, restricting such deployment to the oceans on India's eastern seaboard. As a second phase of restricting areas of nuclear weapons deployment, India and Pakistan could apply a similar pledge for the Kashmir region. Such agreements would still leave open a wide swath of territory for basing nuclear weapons. The threat of the use of nuclear weapons in a tactical battlefield scenario in Kashmir could be minimized through the pledges suggested here.

The IAEA Regional Cooperation Agreement and South Asian Frameworks for Environmental Data-Sharing

The IAEA works in collaboration with Bangladesh, India, Pakistan and Sri Lanka on a variety of projects, providing a structure for greater South Asian nuclear transparency. The Regional Co-operative Agreement for Research, Development and Training in Nuclear Science and Technology in Asia and the Pacific (RCA) is described in the IAEA Information Circular 167. The RCA includes the following countries along with the four South Asian countries mentioned above: Australia, Indonesia, Japan, Malaysia,

Myanmar, Mongolia, New Zealand, People's Republic of China, Philippines, Republic of Korea, Singapore, Thailand and Vietnam.

The RCA provides a valuable framework for promoting greater Indian and Pakistani (and South Asian) cooperation. India is one of the principal countries involved in creating and maintaining the RCA. In the mid-1960's, a collaborative project between India, the Philippines and the IAEA formed a precursor and the genesis of the RCA. India has since then remained very active in regional cooperation and the RCA. Through the IAEA, the Indian Department of Atomic Energy (IDAE) provides training facilities and fellowships to numerous foreign visitors. These services are also provided to individuals from countries with which India has bilateral agreements. In 1999, a Cooperation Plan was signed between the Indian Atomic Energy Commission (a part of the IDAE) and the Vietnam Atomic Energy Commission for cooperation in the field of nuclear power, exchange of scientists and assistance in setting up a training center at Vietnam. In 1999, the Bhabha Atomic Research Centre (BARC) in India trained 6 scientists from Bangladesh, 1 from Myanmar, 1 from Romania, 1 from Thailand, and 4 from Vietnam[20]. Pakistan joined the RCA on September 6, 1974 (three months after India's first nuclear explosion). An example of Pakistani involvement in the RCA is the workshop hosted by Pakistan in 1999 on a "Review Meeting to Analyze a Regional Database on Marine Radioactivity". Given the involvement of India and Pakistan in the RCA, as well as that of Bangladesh and Sri Lanka, the RCA provides a structure within which a sub-regional grouping could focus on South Asian issues.

Three of the four South Asian countries involved in nuclear activities (Bangladesh, India and Pakistan) operate research reactors. Bangladesh's Atomic Energy Research Establishment (BAERE) operates a 3 MW TRIGA Mark II research reactor in Savar, near Dhaka. This research reactor is under full IAEA safeguards. Indian research reactors are not under IAEA safeguards. Two of Pakistan's research reactors (PARR-1 and PARR-2) in Rawalpindi are under IAEA safeguards. Demonstrating systems that can monitor the operations of research reactors and share the information cooperatively can be a key component of South Asian nuclear transparency measures. A beginning in this direction could be made using the facilities of a neutral third party such as Bangladesh. Technical assistance could be provided through the Japan Atomic Energy Research Institute's Department of Research Reactors at the Tokai Research Establishment (JAERI) that regularly hosts international visitors, and held the Third Asian Research Reactors Symposium. The facility in Bangladesh could play a useful role in initiating a South Asian process of sharing information on research reactors. The BAERE 3 MW TRIGA research reactor could be used as a test facility to demonstrate the feasibility of remote monitoring of power and fissile material production. The BAERE has had close working relationships with the JAERI; and, scientists from the BAERE have proposed that the Nuclear Data Center at JAERI be used as an umbrella to establish a regional nuclear data center for Asia and the Pacific[21].

Unlike the situation with research reactors, both India and Pakistan have nuclear power reactors under IAEA safeguards. These facilities provide another opportunity for using the RCA to foster nuclear transparency in South Asia. Some of the facilities at the

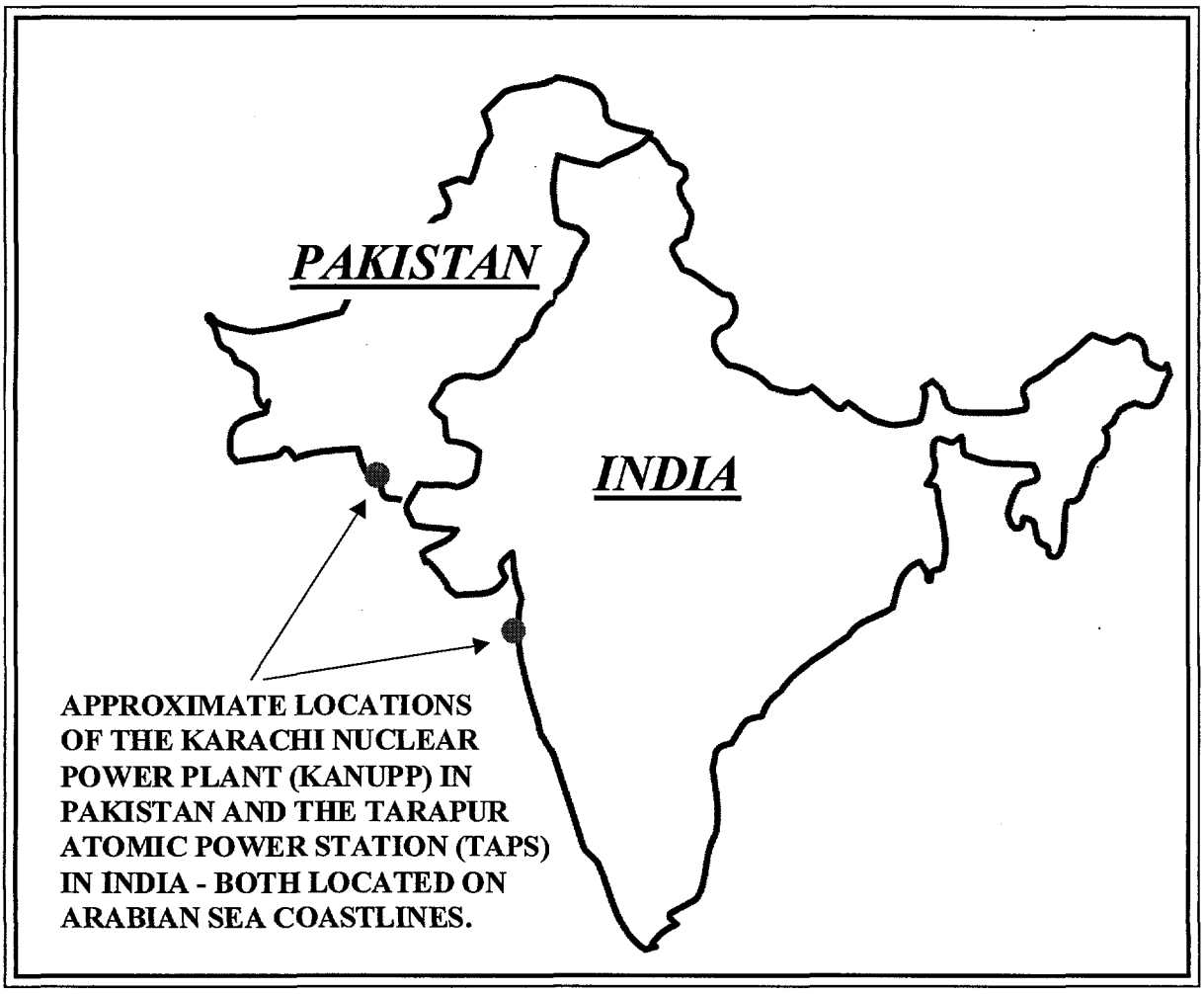
Tarapur Atomic Power Station (TAPS), north of the city of Mumbai in India, and the Karachi Nuclear Power Plant (KANUPP) in Karachi, Pakistan, are under International Atomic Energy Agency (IAEA) safeguards. Facilities such as these - each being under IAEA safeguards (though only parts of TAPS are under safeguards) - could provide locations for demonstrating nuclear transparency and nuclear information sharing technologies.

The founding statute of the IAEA states - among other rights and responsibilities – that the IAEA requires the "observance of any health and safety measures prescribed by the Agency". Having facilities under IAEA safeguards requires India and Pakistan to provide operational data, material accounting, and environmental release data from these facilities to the IAEA. This opens up the possibility that such information could also be shared bilaterally. However, a question that arises is – under what framework or existing agreement should India and Pakistan share environmental or effluent release data of any sort from the nuclear facilities under safeguards? IAEA inspection reports are not made public; and, therefore, supplemental safeguards would be needed for India and Pakistan to share IAEA inspection data bilaterally.

Regional Data Sharing Frameworks

A framework under which limited environmental release and effluent data from TAPS and KANUPP could be shared is provided by the South Asian Seas Action Plan to which India and Pakistan are signatories. Both these facilities are located on the coast, impact coastal regions and are potential thermal, chemical and radioactive pollutant sources. Figure 2 depicts the approximate locations of the TAPS and KANUPP facilities on the Arabian Sea coasts. Sharing information on these facilities is suggested in the South Asian Seas Action Plan that has been created to implement requirements of the United Nations Convention on the Law of the Sea (UNCLOS). With the assistance of the United Nations Environment Program, various regions of the world have set up Regional Seas Programs to implement UNCLOS. The South Asian Regional Seas Program involves the marine member states of South Asia: Bangladesh, India, Maldives, Pakistan, and Sri Lanka. These countries adopted a South Asian Seas Action Plan at a meeting of plenipotentiaries in New Delhi in March 1995; the plan came into force in January 1998. The South Asia Co-operative Environment Programme (SACEP)[22] has been designated as the Secretariat for the implementation of the Action Plan. SACEP was established through the initiative of the United Nations Environment Program–Regional Office of Asia Programs. The member countries of SACEP are Afghanistan (not an active member), Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

FIGURE 2: APPROXIMATE LOCATIONS OF THE TAPS AND KANUPP NUCLEAR FACILITIES LOCATED ON THE COASTLINES OF INDIA AND PAKISTAN ON THE ARABIAN SEA.



One of the key elements of the South Asian Seas Action Plan is to encourage collaboration among regional scientists and technicians and their institutions through the establishment of coordinated regional marine pollution monitoring programs. The UNCLOS has specific provisions relating to the prevention, reduction, and control of marine pollution from land-based activities. In keeping with these provisions, Annex IV of the South Asian Seas Action Plan includes a "Regional Program of Action for the Protection of the Marine Environment of the South Asian Seas from Land-based Activities." The proposed activities include the "Development of a Regional Program for Monitoring of Marine Pollution in the Coastal Waters of the South Asian Seas and the Regular Exchange of Relevant Data and Information."

The BARC in India has initiated two projects in the marine pollution area. One involves the use of radiotracers in the Hoogli estuary near Calcutta. In this study, the BARC has released and tracked 8 Curies of a radioactive Scandium isotope in the form of Scandium glass from disposal sites of materials dredged from Calcutta Port. The other BARC marine research project is in cooperation with the MS Swaminathan Research Foundation in India and involves the use of "Nuclear and Biotechnological Tools in Coastal Systems Research"[23]. Given this interest in the marine coastal environment, the BARC could be a suitable partner for supporting the South Asian Seas Action Plan.

The RCA has an existing project underway to study the "Management of the Marine Coastal Environment and its Pollution". Australia is the lead country for this project. This project on marine pollution is one of five sub-projects under a larger project on "Better Management of the Environment, Natural Resources and Industrial Growth through Isotopes and Radiation Technology" funded jointly by the UN Development Program (UNDP) and the IAEA. The RCA marine project is currently seeking to identify suitable sites within the Asia-Pacific region to conduct technology demonstrations and studies.

As an existing regional framework for the sharing of coastal environmental monitoring data, the South Asian Seas Action Plan promotes Indian and Pakistani sharing of environmental release and effluent data on TAPS and KANUPP. Linking the South Asian Seas Action Plan with the RCA would provide the framework under which such Indian and Pakistani nuclear collaboration could occur.

Nuclear-related Programs of the Food and Agriculture Organization (FAO) of the United Nations

India and Pakistan are members of the FAO of the United Nations. In October 1964, the FAO teamed with the IAEA to develop a Joint Division of Nuclear Techniques in Food and Agriculture. This Joint Division unified FAO's atomic energy branch and the IAEA's agricultural unit. Nuclear technologies have been used in food and agriculture for plant mutation breeding, sterile insect techniques for pest control, food irradiation for improving crop and livestock production, and improved soil and water management using, for example, radioactive isotopes as tracers. The Indian and Pakistani membership in the FAO provides an opportunity for technological collaboration in nuclear fields.

The FAO Soils Bulletin 61 presents a detailed review of issues related to "Radioactive fallout in soils, crops and food"[24]. The FAO has recognized the importance of early action in mitigating the effects of radioactive fallout and is a party to the IAEA international conventions on "Early Notification of a Nuclear Accident" and "Assistance in the Case of a Nuclear Accident or Radiological Emergency". Intervention levels have been determined for food and crops that have increased radioactivity levels after a nuclear accident. The FAO helps provide consistency in the regulations countries impose on the import and export of food products tainted with radioactive fallout. Based on the "Chernobyl" experience, the FAO has determined that there exists a need for improved communication to the farm level, and has suggested the creation of independent facilities

for local monitoring, especially within the 150-km range of nuclear installations. The FAO suggests the setting up of small highly mobile units with trained personnel and relatively simple portable equipment to detect any significant rise in radioactivity level, e.g., in rainfall over pasture or crops. Such units could visit worried communities, communicate in simple language, and obviate unnecessary suspicion or alarm. These suggestions of the FAO provide opportunities for Indian and Pakistani nuclear collaboration. Joint experiments on monitoring airborne emissions of radionuclides could be conducted within a 150-km radius of nuclear power plants as a start towards planning for mitigating the effects of an accident on food crops. These experiments could demonstrate radionuclide samplers, data logging and telemetry technologies.

The FAO/IAEA Joint Division of Nuclear Techniques in Food and Agriculture has a project involving India and Pakistan on the "Management of nutrients and water in rain-fed arid and semi-arid areas for increasing crop production" that includes participation by Indian and Pakistani research institutes. The Indian and Pakistani institutes participate in contracts that form a part of this project. The Nuclear Research Laboratory of the Indian Agricultural Research Institute in New Delhi is working on the "Use of nuclear techniques to improve management practices and increase crop production in rain-fed areas with limited water resources". In Pakistan, the Nuclear Agriculture Division of the Nuclear Institute for Food and Agriculture in Peshawar is working on "Increasing crop production in rain-fed areas by improved water and nutrient management using nuclear techniques". Such joint Indian and Pakistani involvement in common FAO nuclear-related projects could be nurtured to increasingly deal with more sensitive subjects. For example, a project that monitors Cesium-137 levels in desert soils as a measure of erosion could demonstrate technologies that might form a part of future cooperative surveillance of nuclear test sites. Joint surveillance could verify and increase mutual confidence in a nuclear test ban.

IAEA Safeguards Agreements

India and Pakistan both subscribe to site- or material-specific safeguards agreements modeled on the IAEA's Information Circular 66 (INFCIRC/66). These safeguard agreements have emerged out of the purchase of foreign nuclear technologies. Table 3 lists Indian and Pakistani facilities under IAEA safeguards. The safeguard agreements are designed to prevent the diversion of nuclear material from peaceful to weapons-oriented uses.

Table 3: Indian and Pakistani Facilities Under IAEA Safeguards

Country	Type of Facility	Name of Facility	Location
INDIA	Power reactors	RAPS—Rajasthan Atomic Power Station	Rawatbhata, Rajasthan
		TAPS	Tarapur, Maharashtra
	Fuel fabrication plants	Select areas of the Nuclear Fuels Complex (NFC)	Hyderabad, Andhra Pradesh
	Chemical reprocessing plants	PREFRE—Power Reactor Fuel Reprocessing Facility	Tarapur, Maharashtra
	Separate storage facilities	AFR—Away From the Reactor nuclear fuels storage facility	Tarapur, Maharashtra
PAKISTAN	Power reactors	KANUPP	Karachi, Sindh
		CHASNUPP-1—Chashma Nuclear Power Plant	Kundian, Punjab
	Research reactors and critical assemblies	Pakistan Atomic Research Reactor (PARR)-1	Rawalpindi, Punjab
	Separate storage facilities	PARR-2	Rawalpindi, Punjab
		Hawks Bay Depot	Karachi, Sindh

There is no legal obligation on either India or Pakistan to strengthen existing IAEA safeguards. However, there are many voluntary steps that each country could take in this direction. A simple first step could involve releasing data each supplies to the IAEA for review by the other. Further, facilities not under safeguards could be temporarily opened for IAEA inspection, especially for safety audits and reviews.

International Nuclear-Related Agreements

This section summarizes the main reporting requirements of the agreements mentioned in Table 2. Only one of India or Pakistan has signed many of these agreements. Therefore, there is a need to press India and Pakistan to sign on to existing nuclear-related agreements, along with the ongoing international pressure for them to sign the major nonproliferation treaties, such as the CTBT and the NPT. Signing nuclear-related agreements has the benefit that, if both countries become signatories to an agreement, they can begin to share the information required by the agreement. Another benefit is that when a country becomes a party to an existing nuclear-related agreement it enters more fully into the fold of the established international legal framework. Eventually, this process could culminate in the signing of the more contentious treaties that the international community wishes to promote.

The major types of information that could be or are being shared using existing frameworks involve the following:

- laws and regulations (including internal inspection procedures that enforce compliance);
- lists of nuclear facilities;
- emergency response procedures and available resources;

- information related to the transport of nuclear wastes (particularly via shipping);
- understanding and notifying accidental releases
- peaceful research in Antarctica, and verifying the non-disposal of radioactive substances in the Antarctic region.

Many of these reporting requirements could translate into specific projects involving the demonstration of monitoring and verification technologies. Such demonstration projects would help to allay the concerns of policy-makers opposed to greater nuclear transparency from a sense of mistrust. A list of such projects is provided in Table 5.

SHARING NUCLEAR-RELATED INFORMATION

To promote incremental progress in nuclear transparency, nuclear-related information currently being shared by India and Pakistan could pass through equivalent and mutually understood information management infrastructures within each country. Such an infrastructure could consist of dedicated nodal agencies created on each side, with the participation of personnel from the defense, foreign affairs and nuclear ministries and other security agencies. (See Figure 1.) The information-sharing process would be defined and understood on both sides by key policy and decision-makers dealing with nuclear and security issues. As future agreements are negotiated, the existence of an information-sharing infrastructure would facilitate the transfer of progressively more sensitive information. A single agency serving as a point of contact for sharing nuclear-related information could make it easier to shut off all information flows in a situation of worsening relations. However, the ability to tightly control nuclear information transfer is what would convince policy makers to increase the sensitivity of the information being shared.

Transparency in the sharing of nuclear information could begin by India and Pakistan cooperating in the following analysis:

- Describing to each other the type of on-going nuclear information flows to and from the IAEA and to other international bodies. (This description would not entail the actual sharing of sensitive information, but a description of the types of information being shared.)
- Compiling and passing through a single nodal agency the nuclear information currently being shared with each other.
- Incrementally enhancing the sensitivity of information being shared.

Once this analysis is complete, it will allow efficient reporting of nuclear information between India and Pakistan and enhance the prospects of greater transparency. As future nuclear transparency measures are negotiated, a well-defined infrastructure for information reporting will allow for rapid implementation.

Prospects for Indian and Pakistani Nuclear Information Sharing

Table 4 summarizes the reporting requirements of various existing nuclear-related agreements between India and Pakistan. As can be seen from this table, there is some overlap between the information flows required by each agreement. Detailing the exact reporting requirements of each agreement and passing it through a single point of contact prevents unnecessary duplication. Having a clear understanding of the kind of information being shared also precludes a situation in which a concerned agency might deny release of data that is already freely available from another source.

TABLE 4: CONVENTIONS/ AGREEMENTS WITH REPORTING REQUIREMENTS

Treaty/ Convention/ Agreement	**Reporting Requirements**
Agreement on the Prohibition of Attack Against Nuclear Installations and Facilities	List of nuclear installations and facilities Longitudes and latitudes
The Antarctic Treaty	Collaborative research, on-site inspections
Code of Practice on the International Transboundary Movement of Radioactive Waste	Sharing of information on national laws and regulations Notification of shipments
Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	List of experts, equipment and emergency response materials
Convention Concerning the Protection of Workers Against Ionizing Radiation	Sharing of information on national laws and regulations
Convention on Early Notification of a Nuclear Accident	Accident time, location, radiation releases, and other data essential for assessing the situation
Convention on Nuclear Safety	Detailed safety report on civilian nuclear power plants for peer review
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	Sharing of information on national laws and regulations Notification of any allowed dumping activities
International Convention for the Safety of Life at Sea	Sharing of information on national laws and regulations
Regional Co-operative Agreement for Research, Development and Training in Nuclear Science and Technology in Asia and the Pacific.	Operational data, material accounting, environmental releases
Food and Agriculture Organization of the United Nations – nuclear projects	Project reports on contracts related to the use of nuclear technologies in food and agriculture
Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water	Information demonstrating no cross-border transport of radioactive debris from underground tests
United Nations Convention on the Law of the Sea	South Asian Seas Action Plan Information on sea lanes and traffic separation rules for nuclear cargo

SUMMARY AND CONCLUSIONS

This paper has identified several information-sharing opportunities that arise out of the various nuclear-related conventions that India and Pakistan have signed. The opportunities that arise out of bilateral and regional agreements are:

- Use the list of nuclear installations and facilities exchanged annually as a part of the No-Attack agreement to create a cooperative database of publicly available information.
- Include some limited ground-truth data along with the annually exchanged list to make analyses of satellite imagery of nuclear facilities more transparent.
- Expand the No-Attack agreement to a No Preemptive Strikes agreement by formally agreeing to store nuclear weapons at locations from among the list of nuclear facilities prohibited from attack.
- Link the RCA and the South Asian Seas Action Plan to share data on the coastal nuclear facilities of TAPS and KANUPP that are under safeguards.
- Use a Bangladeshi research reactor as a test-bed for demonstrating monitoring technologies through the RCA framework.
- Promote bilateral nuclear-related projects through the FAO that use radioactive tracers for monitoring soil erosion and irrigation practices – for example, track Cesium-137 concentrations in desert soils to assess soil erosion, plan and monitor radioactive emissions from nuclear power plants for potential effects on agriculture.

Opportunities for information sharing also arise out of international nuclear-related agreements that either India and/or Pakistan has signed. The opportunities are:

- Create bilateral cooperative scientific research programs in Antarctica that could be duplicated in the Siachen glacier region of the Himalayas. The Antarctica cooperation could involve Pakistani scientists staying over the winter at the Indian permanent Antarctic station, Maitri.
- Share information on international transboundary shipments of radioactive wastes
- Share information on experts, equipment and other materials available for dealing with nuclear accidents.
- Share information on codes, regulations and inspection procedures to protect workers from ionizing radiation.
- Share baseline radionuclide release concentrations at select nuclear facilities and other related information (such as meteorological data) to understand unambiguously the effects of releases from potential nuclear accidents.
- Share safety reports for commercial nuclear power plants
- Share information on rules established for any dumping of radioactive materials at sea.
- Share information on planned responses to nuclear emergencies involving ships.
- Share information on radioactivity released from underground nuclear tests.
- Share information on designated sea-lanes for the transport of nuclear cargo

Among these information-sharing opportunities, there are seven that lend themselves well to technology-based cooperative monitoring projects. Table 5 lists these projects, the parameters that could be monitored and the technologies that would be used to implement the projects.

TABLE 5: Technology-based Nuclear Transparency Projects Involving Cooperative Monitoring

PROJECTS (and agreements providing enabling framework)	**PARAMETERS TO BE MONITORED**	**TECHNOLOGIES TO BE USED**
Creating a cooperative database referenced to the list of nuclear facilities exchanged annually by India and Pakistan as a part of the No-Attack Agreement (Agreement on the Prohibition Against Attack on Nuclear Facilities and Installations).	Publicly available information on nuclear facilities	Computers, Internet.
Sharing of thermal, chemical and radionuclide release data from the TAPS and KANUPP coastal nuclear facilities (IAEA Regional Cooperative Agreement for Research, Development and Training in Nuclear Science and Technology in Asia and the Pacific; South Asian Seas Action Plan).	Concentrations of select chemicals and radionuclides of concern that can serve as indicative tracers in various environmental media – for example, concentrations of Cesium in waters of tidal creeks, sediments, biota; temperatures of discharged effluents	Radiation monitors, thermocouples, remote data acquisition systems, telemetry, sample collection and laboratory analyses.
Sharing baseline radionuclide release concentrations at select nuclear facilities and other related information (such as meteorological data) to understand unambiguously the effects of potential nuclear accidents (Lahore MoU; Convention on the Early Notification of Nuclear Accidents).	Meteorological data, land use, baseline concentrations of select radionuclides in air, water, soils and biota	Meteorological stations, radiation monitors, sample collection and laboratory analyses, telemetry.
Planning for the monitoring of airborne radioactivity within a 150 km. radius of nuclear facilities for mitigating effects of nuclear accidents on agriculture (FAO projects related to the Convention on the Early Notification of Nuclear Accidents).	Meteorological data, land use, baseline concentrations of select radionuclides in air, water, soils and biota	Meteorological stations, radiation monitors, sample collection and laboratory analyses, telemetry.
Monitoring soil erosion in desert soils using Cesium-137 as a tracer (FAO projects on the use of nuclear techniques for improved agricultural practices).	Soil moisture content, meteorological data, Cesium-137 concentrations in surface soils	Moisture probes, meteorological stations, telemetry, radiation monitors, sample collection and laboratory analyses.
Monitoring the Bangladeshi TRIGA Mark II research reactor as a technology demonstration test-bed (IAEA RCA).	Temperature increases in coolants, radiation levels at shallow low-level radioactive waste disposal sites	Radiation monitors, flow meters, thermocouples, telemetry, sample collection and laboratory analyses.
Cooperative scientific research in Antarctica (Antarctic Treaty).	Field observations in geology, climatology, marine science, glaciology and antarctic biology	Video-feed from remote locations, field analytical sensors, sample collection and laboratory analyses.

Conclusions

There are two nuclear-related agreements that Pakistan has acceded to but not India: Convention on Nuclear Safety, and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. Similarly, there are five nuclear-related agreements that India has acceded to but not Pakistan: the Antarctic Treaty, Convention Concerning the Protection of Workers against Ionizing Radiation, Convention on the Liability of Operators of Nuclear Ships, Treaty on the Prohibition of the Emplacement of Nuclear and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof, United Nations Convention on the Law of the Sea. The nuclear-related agreements unsigned by India and Pakistan present opportunities for pressing these two countries for greater nuclear transparency and cooperation.

Many of the agreements that have been signed by India and Pakistan involve the sharing of information. Incrementally increasing the sensitivity of the information being shared will strengthen norms for nuclear transparency. Basing the nuclear information sharing process within a South Asian context involving Bangladesh and Sri Lanka could be a suitable starting point. The RCA involves India and Pakistan in a regional nuclear-related cooperation agreement spanning the entire Asia Pacific region. Within the structure of the RCA, South Asian nuclear-related projects could be initiated that would be restricted to non-sensitive nuclear issues. Table 5 has listed suggestions for some projects and the existing agreements that provide an information-sharing framework. Eventually, these projects could create an atmosphere conducive to bilateral Indian and Pakistani nuclear transparency projects. Incrementally, as the number of such nuclear transparency projects grows, the level of sensitivity of the nuclear information being shared could be increased.

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[1] Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

[2] The term nuclear-related is used somewhat loosely, as several agreements are discussed whose main purpose, for example, is the protection of an ocean or other natural resource. These agreements do include articles on nuclear issues or radioactive substances and so are considered nuclear-related.

[3] South Asia is usually thought to consist of the countries of Afghanistan, Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal, Pakistan, and Sri Lanka. China is sometimes viewed as both a South Asian and an East Asian country. Similarly, Iran can also be viewed as both a South Asian and a West Asian country. In this paper, I define South Asia in the more conventional manner, using the shorter list enumerated here.

[4] Elbaradei, M., E. Nwogugu and J. Rames (1999), International Law and Nuclear Energy: Overview of the Legal Framework. Available on the IAEA web-site at - http://www.iaea.or.at/worldatom/inforesource/bulletin/bull373/rames.html

[5] The agreements not specifically discussed by Elbaradei, Nwogugu and Rames (1999) are the Indian and Pakistani Agreement on the Prohibition of Attack Against Nuclear Installations and Facilities, the Convention for the Protection of Workers Against Ionizing Radiation and the Convention on the Liability of Operators of Nuclear Ships. The South Asian Seas Action Plan and the South Asia Cooperative Environment Program are also discussed in here as these agreements provide a framework for sharing environmental data from nuclear facilities located on the Indian and Pakistani coasts.

[6] Cossa, R.A., 1998, PACATOM: Building Confidence and Enhancing Transparency, A CSCAP Working Group Special Report, Occasional Paper, Pacific Forum CSIS, Honolulu, Hawaii, USA.

[7] International Atomic Energy Agency, 1999, Annual Report for 1998, http://www.iaea.org/worldatom/Documents/Anrep/Anrep98

[8] TERI, 1999, Tata Energy Research Institute, 1999, Quoted from the SAFIR web site: http://www.safir.teri.res.in/about/about.htm.

[9] Tahir-Kheli, S. and K.L. Biringer, 2000, Beyond Kargil: The Technology of Peace in India-Pakistan Agreements, (to be published).

[10] Fetter, S., 1999, A Comprehensive Transparency Regime for Warheads and Fissile Materials, Arms Control Today, January-February, published by Arms Control Association, Washington D.C., USA.

[11] The Tokyo Forum included four members of the Canberra Commission on the Elimination of Nuclear Weapons, and was convened following the May 1998 nuclear tests of India and Pakistan. One of the Tokyo Forum's key recommendations is to "Adopt nuclear transparency measures. Irreversible reductions in nuclear forces require great transparency. The Tokyo Forum welcomes the transparency measures undertaken so far by the nuclear-weapon states and calls on them to take steps to increase transparency further. Recent transparency measures by the United Kingdom and France have shed considerable light on their nuclear weapons numbers and stocks. These could be further developed. The United States has put in place many transparency measures concerning its doctrines, deployments and technical developments. More information on reserve stocks would have a positive impact on steps towards nuclear disarmament. The Russian Federation has declared some aspects of its nuclear weapons program. The Russian Federation could increase the degree of transparency concerning doctrine, numbers of tactical nuclear weapons and stocks of fissile material. China has put in place few transparency measures. The implementation of further transparency measures on the numbers and types of nuclear weapons and on the amounts of fissile material should be encouraged in view of the favorable regional and global impact."

[12] Lewis, P., 2000, Facing Nuclear Dangers: an Action Plan for the 21st Century, Disarmament Forum, Vol. One, published by the United Nations Institute for Disarmament Research, Geneva. http://www.unog.ch.unidir

[13]News Network International, 1999, FPCCI demands machinery import from India, June 1, http://www.nni-news.com/nni/today/page14.htm

[14] An international convention on nuclear terrorism is also currently being discussed by UN members, including India and Pakistan

[15] Existing nuclear-related agreements that neither India nor Pakistan has signed are (in alphabetical order)–

- Comprehensive Nuclear Test Ban Treaty
- Convention on the Establishment of a Security Control in the Field of Nuclear Energy (restricted to Western European nations)
- Convention on the Physical Protection of Nuclear Materials
- Convention on the Prevention of Marine Pollution from Land-Based Sources
- Convention on Supplementary Compensation for Nuclear Damage
- Convention on Third Party Liability in the Field of Nuclear Energy and associated Protocols
- Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
- Nuclear Non-proliferation Treaty
- Vienna Convention on Civil Liability for Nuclear Damage and associated Protocols (e.g. Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage)
- Various treaties on nuclear weapons free zones at different locations around the world.

[16] In October 1964, the FAO and the IAEA established a Joint Division of Nuclear Techniques in Food and Agriculture.

[17] These agreements were entered into at various times, as each country procured foreign technologies that were sold under conditions of safeguards

[18] See, for example, Karl, D.J., 1996, Proliferation Pessimism and Emerging Nuclear Powers, International Security, Vol. 21, No. 3, pages 67-119.

[19] It can be argued that agreements prohibiting attack cannot be trusted. Adolph Hitler, after all, attacked Poland after promising Neville Chamberlain that he would not. However, though a country may not trust a No-Attack agreement enough to drop its defenses, the existence of an agreement can affect the operational readiness and status of a force. Weapons, for example, can be kept in a state of de-alertment more easily in a time of peace. The absence of an agreement is certainly worse than having one.

[20] Bhabha Atomic Research Centre, 1999, BARC Newsletter, No. 187, September, Mumbai, India.

[21] Bhutyan, S.I. and N.I. Molla, 1995, Nuclear Data Activity at Atomic Energy Research Establishment, Savar, Dhaka, Proceedings, Japan Atomic Energy Research Institute Conference, Paper 008.

[22] SACEP came into existence in February 1981 at a meeting of the Environment Ministers of the member countries with the adoption of the Colombo Declaration and the Articles of Association of SACEP.

[23] Bhabha Atomic Research Centre, 1998, RCA Annual Report, Mumbai, India. Available at – http://www.barc.ernet.in/rca_india/annual_report.html.

[24] Food and Agriculture Organization, 1989, Radioactive fallout in soils, crops and food, FAO SOILS BULLETIN 61. A background review prepared by F.P.W. Winteringham for the FAO Standing Committee on Radiation Effects, the FAO Land and Water Development Division and the Joint FAD/IAEA Division on Nuclear Techniques in Food and Agriculture.
http://www.fao.org/docrep/t0228e/T0228E00.htm#Contents.