Annex I – Nuclear-related measures

A. GENERAL

1. The sequence of implementation of the commitments detailed in this Annex is specified in Annex V to the Joint Comprehensive Plan of Action (JCPOA). Unless otherwise specified, the durations of the commitments in this Annex are from Implementation Day.

B. ARAK HEAVY WATER RESEARCH REACTOR

2. Iran will modernise the Arak heavy water research reactor to support peaceful nuclear research and radioisotopes production for medical and industrial purposes. Iran will redesign and rebuild the reactor, based on the agreed conceptual design (as attached to this Annex) to support its peaceful nuclear research and production needs and purposes, including testing of fuel pins and assembly prototypes and structural materials. The design will be such as to minimise the production of plutonium and not to produce weapon-grade plutonium in normal operation. The power of the redesigned reactor will not exceed 20 MWth. The E3/EU+3 and Iran share the understanding that the parameters in the conceptual design are subject to possible and necessary adjustments in developing the final design while fully preserving the above-mentioned purposes and principles of modernisation.

3. Iran will not pursue construction at the existing unfinished reactor based on its original design and will remove the existing calandria and retain it in Iran. The calandria will be made inoperable by filling any openings in the calandria with concrete such that the IAEA can verify that it will not be usable for a future nuclear application. In redesigning and reconstructing of the modernized Arak heavy water research reactor, Iran will maximise the use of existing infrastructure already installed at the current Arak research reactor.

4. Iran will take the leadership role as the owner and as the project manager, and have responsibility for overall implementation of the Arak modernisation project, with E3/EU+3 participants assuming responsibilities regarding the modernisation of the Arak reactor as described in this Annex. A Working Group composed of E3/EU+3 participants will be established to facilitate the redesigning and rebuilding of the reactor. An international partnership composed of Iran and the Working Group would implement the Arak modernisation project. The Working Group could be enlarged to include other countries by consensus of the participants of the Working Group and Iran. E3/EU+3 participants and Iran will conclude an official document expressing their strong commitments to the Arak modernisation project in advance of Implementation Day which would provide an assured path forward to modernise the reactor and would define the responsibilities assumed by the E3/EU+3 participants, and subsequently contracts would be concluded. The participants of the Working Group will provide assistance needed by Iran for redesigning and rebuilding the reactor, consistent with their respective national laws, in such a manner as to enable the safe and timely construction and commissioning of the modernised reactor.

5. Iran and the Working Group will cooperate to develop the final design of the modernised reactor and the design of the subsidiary laboratories to be carried out by Iran, and review conformity with international safety standards, such that the reactor can be licensed by the relevant Iranian regulatory authority for commissioning and operation. The final design of the modernised reactor and the design of the subsidiary laboratories will be submitted to the Joint Commission. The Joint Commission will aim to complete its review and endorsement within three months after the submission of the final design. If the Joint Commission does not complete its review and endorsement within three months, Iran could raise the issue through the dispute resolution mechanism envisaged by this JCPOA.

6. The IAEA will monitor the construction and report to the Working Group for confirmation that the construction of the modernised reactor is consistent with the approved final design.

7. As the project manager, Iran will take responsibility for the construction efforts. E3/EU+3 parties will, consistent with their national laws, take appropriate administrative, legal, technical, and regulatory measures to support co-operation.

   E3/EU+3 parties will support the purchase by Iran, the transfer and supply of necessary materials, equipment, instrumentation and control systems and technologies required for the construction of the redesigned reactor, through the mechanism established by this JCPOA, as well as through exploration of relevant funding contributions.

8. E3/EU+3 parties will also support and facilitate the timely and safe construction of the modernized Arak reactor and its subsidiary laboratories, upon request by Iran, through IAEA technical cooperation if appropriate, including but not limited to technical and financial assistance, supply of required materials and equipment, state-of-the-art instrumentation and control systems and equipment and support for licensing and authorization.

9. The redesigned reactor will use up to 3.67 percent enriched uranium in the form of UO2 with a mass of approximately 350 kg of UO2 in a full core load, with a fuel design to be reviewed and approved by the Joint Commission. The international partnership with the participation of Iran will fabricate the initial fuel core load for the reactor outside Iran. The international partnership will cooperate with Iran, including through technical assistance, to fabricate, test and license fuel fabrication capabilities in Iran for subsequent fuel core reloads for future use with this reactor. Destructive and non-destructive testing of this fuel including Post-Irradiation-Examination (PIE) will take place in one of the participating countries outside of Iran and that country will work with Iran to license the

subsequent fuel fabricated in Iran for the use in the redesigned reactor under IAEA monitoring.

10. Iran will not produce or test natural uranium pellets, fuel pins or fuel assemblies, which are specifically designed for the support of the originally designed Arak reactor, designated by the IAEA as IR-40. Iran will store under IAEA continuous monitoring all existing natural uranium pellets and IR-40 fuel assemblies until the modernised Arak reactor becomes operational, at which point these natural uranium pellets and IR-40 fuel assemblies will be converted to UNH, or exchanged with an equivalent quantity of natural uranium. Iran will make the necessary technical modifications to the natural uranium fuel production process line that was intended to supply fuel for the IR-40 reactor design, such that it can be used for the fabrication of the fuel reloads for the modernised Arak reactor.

11. All spent fuel from the redesigned Arak reactor, regardless of its origin, for the lifetime of the reactor, will be shipped out of Iran to a mutually determined location in E3/EU+3 countries or third countries, for further treatment or disposition as provided for in relevant contracts to be concluded, consistent with national laws, with the recipient party, within one year from the unloading from the reactor or whenever deemed to be safe for transfer by the recipient country.

12. Iran will submit the DIQ of the redesigned reactor to the IAEA which will include information on the planned radio-isotope production and reactor operation programme. The reactor will be operated under IAEA monitoring.

13. Iran will operate the Fuel Manufacturing Plant only to produce fuel assemblies for light water reactors and reloads for the modernized Arak reactor.

C. HEAVY WATER PRODUCTION PLANT

14. All excess heavy water which is beyond Iran's needs for the modernised Arak research reactor, the Zero power heavy water reactor, quantities needed for medical research and production of deuterate solutions and chemical compounds including, where appropriate, contingency stocks, will be made available for export to the international market based on international prices and delivered to the international buyer for 15 years. Iran's needs, consistent with the parameters above, are estimated to be 130 metric tonnes of nuclear grade heavy water or its equivalent in different enrichments prior to commissioning of the modernised Arak research reactor, and 90 metric tonnes after the commissioning, including the amount contained in the reactor.

15. Iran will inform the IAEA about the inventory and the production of the HWPP and will allow the IAEA to monitor the quantities of the heavy water stocks and the amount of heavy water produced, including through IAEA visits, as requested, to the HWPP.

D. OTHER REACTORS

16. Consistent with its plan, Iran will keep pace with the trend of international technological advancement in relying only on light water for its future nuclear power and research reactors with enhanced international cooperation including assurances of supply of necessary fuel.

17. Iran intends to ship out all spent fuel for all future and present nuclear power and research reactors, for further treatment or disposition as provided for in relevant contracts to be concluded consistent with national laws with the recipient party.

E. SPENT FUEL REPROCESSING ACTIVITIES

18. For 15 years Iran will not, and does not intend to thereafter, engage in any spent fuel reprocessing or spent fuel reprocessing R&D activities. For the purpose of this annex, spent fuel includes all types of irradiated fuel.

19. For 15 years Iran will not, and does not intend to thereafter, reprocess spent fuel except for irradiated enriched uranium targets for production of radio-isotopes for medical and peaceful industrial purposes.

20. For 15 years Iran will not, and does not intend to thereafter, develop, acquire or build facilities capable of separation of plutonium, uranium or neptunium from spent fuel or from fertile targets, other than for production of radio-isotopes for medical and peaceful industrial purposes.

21. For 15 years, Iran will only develop, acquire, build, or operate hot cells (containing a cell or interconnected cells), shielded cells or shielded glove boxes with dimensions less than 6 cubic meters in volume compatible with the specifications set out in Annex I of the Additional Protocol. These will be co-located with the modernised Arak research reactor, the Tehran Research Reactor, and radio-medicine production complexes, and only capable of the separation and processing of industrial or medical isotopes and non-destructive PIE. The needed equipment will be acquired through the procurement mechanism established by this JCPOA. For 15 years, Iran will develop, acquire, build, or operate hot cells (containing a cell or interconnected cells), shielded cells or shielded glove boxes with dimensions beyond 6 cubic meters in volume and specifications set out in Annex I of the Additional Protocol, only after approval by the Joint Commission.

22. The E3/EU+3 are ready to facilitate all of the destructive and non-destructive examinations on fuel elements and/or fuel assembly prototypes including PIE for all fuel fabricated in or outside Iran and irradiated in Iran, using their existing facilities outside Iran. Except for the Arak research reactor complex, Iran will not develop, build, acquire or operate hot cells capable of performing PIE or seek to acquire equipment to build/develop such a capability, for 15 years.

23. For 15 years, in addition to continuing current fuel testing activities at the TRR, Iran will undertake non-destructive post irradiation examination (PIE) of fuel pins, fuel assembly prototypes and structural materials. These examinations will be exclusively at the Arak research reactor complex. However, the E3/EU+3 will make available their facilities to conduct destructive testing with Iranian specialists, as agreed. The hot cells at the Arak research reactor in which non-destructive PIE are performed will not be physically interconnected to cells that

process or handle materials for the production of medical or industrial radioisotopes.

24. For 15 years, Iran will not engage in producing or acquiring plutonium or uranium metals or their alloys, or conducting R&D on plutonium or uranium (or their alloys) metallurgy, or casting, forming, or machining plutonium or uranium metal.

25. Iran will not produce, seek, or acquire separated plutonium, highly enriched uranium (defined as 20% or greater uranium-235), or uranium-233, or neptunium-237 (except for use as laboratory standards or in instruments using neptunium-237) for 15 years.

26. If Iran seeks to initiate R&D on uranium metal based TRR fuel in small agreed quantities after 10 years and before 15 years, Iran will present its plan to, and seek approval by, the Joint Commission.

F. ENRICHMENT CAPACITY

27. Iran will keep its enrichment capacity at no more than 5060 IR-1 centrifuge machines in no more than 30 cascades in their current configurations in currently operating units at the Natanz Fuel Enrichment Plant (FEP) for 10 years.

28. Iran will keep its level of uranium enrichment at up to 3.67 percent for 15 years.

29. Iran will remove the following excess centrifuges and infrastructure not associated with 5060 IR-1 centrifuges in FEP, which will be stored at Natanz in Hall B of FEP under IAEA continuous monitoring:

29.1. All excess centrifuge machines, including IR-2m centrifuges. Excess IR-1 centrifuges will be used for the replacement of failed or damaged centrifuges of the same type on a one-for-one basis.

29.2. UF6 pipework including sub headers, valves and pressure transducers at cascade level, and frequency inverters, and UF6 withdrawal equipment from one of the withdrawal stations, which is currently not in service, including its vacuum pumps and chemical traps.

30. For the purpose of this Annex, the IAEA will confirm through the established practice the failed or damaged status of centrifuge machines before removal.

31. For 15 years, Iran will install gas centrifuge machines, or enrichment-related infrastructure, whether suitable for uranium enrichment, research and development, or stable isotope enrichment, exclusively at the locations and for the activities specified under this JCPOA.

G. CENTRIFUGES RESEARCH AND DEVELOPMENT

32. Iran will continue to conduct enrichment R&D in a manner that does not accumulate enriched uranium. For 10 years and consistent with its enrichment R&D plan, Iran's enrichment R&D with uranium will only include IR-4, IR-5, IR-6 and IR-8 centrifuges. Mechanical testing on up to two single centrifuges for each type will be carried out only on the IR-2m, IR-4, IR-5, IR-6, IR-6s, IR-7 and IR-8. Iran will build or test, with or without uranium, only those gas centrifuges specified in this JCPOA.

33. Consistent with its plan, Iran will continue working with the 164-machine IR-2m cascade at PFEP in order to complete the necessary tests until 30 November 2015 or the day of implementation of this JCPOA, whichever comes later, and after that it will take these machines out of the PFEP and store them under IAEA continuous monitoring at Natanz in Hall B of FEP.

34. Consistent with its plan, Iran will continue working with the 164-machine IR-4 cascade at PFEP in order to complete the necessary tests until 30 November 2015 or the day of implementation of this JCPOA, whichever comes later, and after that it will take these machines out of the PFEP and store them under IAEA continuous monitoring at Natanz in Hall B of FEP.

35. Iran will continue the testing of a single IR-4 centrifuge machine and IR-4 centrifuge cascade of up to 10 centrifuge machines for 10 years.

36. Iran will test a single IR-5 centrifuge machine for 10 years.

37. Iran will continue testing of the IR-6 on single centrifuge machines and its intermediate cascades and will commence testing of up to 30 centrifuge machines from one and a half years before the end of year 10. Iran will proceed from single centrifuge machines and small cascades to intermediate cascades in a logical sequence.

38. Iran will commence, upon start of implementation of the JCPOA, testing of the IR-8 on single centrifuge machines and its intermediate cascades and will commence the testing of up to 30 centrifuges machines from one and a half years before the end of year 10. Iran will proceed from single centrifuges to small cascades to intermediate cascades in a logical sequence.

39. For 10 years, Iran, consistent with the established practice, will recombine the enriched and depleted streams from the IR-6 and IR-8 cascades through the use

of welded pipework on withdrawal main headers in a manner that precludes the withdrawal of enriched and depleted uranium materials and verified by the IAEA.

40. For 15 years, Iran will conduct all testing of centrifuges with uranium only at the PFEP. Iran will conduct all mechanical testing of centrifuges only at the PFEP and the Tehran Research Centre.

41. For the purpose of adapting PFEP to the R&D activities in the enrichment and enrichment R&D plan, Iran will remove all centrifuges except those needed for testing as described in the relevant paragraphs above, except for the IR-1 cascade (No. 1) as described below. For the full IR-1 cascade (No. 6), Iran will modify associated infrastructure by removing UF6 pipework, including sub-headers, valves and pressure transducers at cascade level, and frequency inverters. The IR-1 cascade (No. 1) centrifuges will be kept but made inoperable, as verified by the IAEA, through the removal of centrifuge rotors and the injection of epoxy resin into the sub headers, feeding, product, and tails pipework, and the removal of controls and electrical systems for vacuum, power and cooling. Excess centrifuges and infrastructure will be stored at Natanz in Hall B of FEP under IAEA continuous monitoring. The R&D space in line No. 6 will be left empty until Iran needs to use it for its R&D programme.

42. Consistent with the activities in the enrichment and enrichment R&D plan, Iran will maintain the cascade infrastructure for testing of single centrifuges and small and intermediate cascades in two R&D lines (No. 2 and No. 3) and will adapt two other lines (No. 4 and No. 5) with infrastructure similar to that for lines No. 2 and No. 3 in order to enable future R&D activities as specified in this JCPoA. Adaptation will include modification of all UF6 pipework (including removal of all sub headers except as agreed as needed for the R&D programme) and associated instrumentation to be compatible with single centrifuges and small and intermediate cascade testing instead of full scale testing.

43. Consistent with its plan and internationally established practices, Iran intends to continue R&D on new types of centrifuges through computer modelling and simulations, including at universities. For any such project to proceed to a prototype stage for mechanical testing within 10 years, a full presentation to, and approval by, the Joint Commission is needed.

H. FORDOW FUEL ENRICHMENT PLANT

44. The Fordow Fuel Enrichment Plant (FFEP) will be converted into a nuclear, physics, and technology centre and international collaboration will be encouraged in agreed areas of research. The Joint Commission will be informed in advance of the specific projects that will be undertaken at Fordow.

45. Iran will not conduct any uranium enrichment or any uranium enrichment related R&D and will have no nuclear material at the Fordow Fuel Enrichment Plant (FFEP) for 15 years.

46. For 15 years, Iran will maintain no more than 1044 IR-1 centrifuge machines at one wing of the FFEP of which:

46.1. Two cascades that have not experienced UF6 before will be modified for the production of stable isotopes. The transition to stable isotope production of these cascades at FFEP will be conducted in joint partnership between the Russian Federation and Iran on the basis of arrangements to be mutually agreed upon. To prepare these two cascades for installation of a new cascade architecture appropriate for stable isotope production by the joint partnership, Iran will remove the connection to the UF6 feed main header, and move cascade UF6 pipework (except for the dump line in order to maintain vacuum) to storage in Fordow under IAEA continuous monitoring. The Joint Commission will be informed about the conceptual framework of stable isotope production at FFEP.

46.2. For four cascades with all associated infrastructure remaining except for pipework that enables crossover tandem connections, two will be placed in an idle state, not spinning. The other two cascades will continue to spin until the transition to stable isotope production described in the previous subparagraph has been completed. Upon completion of the transition to stable isotope production described in the previous subparagraph, these two spinning cascades will be placed in an idle state, not spinning.

47. Iran will:

47.1. remove the other 2 cascades of IR-1 centrifuges from this wing, by removing all centrifuges and cascade UF6 pipework, including sub headers, valves and pressure transducers at cascade level, and frequency inverters.

47.2. also subsequently remove cascade electrical cabling, individual cascade control cabinets and vacuum pumps. All these excess centrifuges and

infrastructure will be stored at Natanz in Hall B of FEP under IAEA continuous monitoring.

48. Iran will:

48.1. remove all excess centrifuges and uranium enrichment related infrastructure from the other wing of the FFEP. This will include removal of all centrifuges and UF6 pipework, including sub headers, valves and pressure gauges and transducers, and frequency inverters and converters, and UF6 feed and withdrawal stations.

48.2. also subsequently remove cascade electrical cabling, individual cascade control cabinets, vacuum pumps and centrifuge mounting blocks. All these excess centrifuges and infrastructure will be stored at Natanz in Hall B of FEP under IAEA continuous monitoring.

49. Centrifuges from the four idle cascades may be used for the replacement of failed or damaged centrifuges in stable isotope production at Fordow.

50. Iran will limit its stable isotope production activities with gas centrifuges to the FFEP for 15 years and will use no more than 348 IR-1 centrifuges for these activities at the FFEP. The associated R&D activities in Iran will occur at the FFEP and at Iran's declared and monitored centrifuge manufacturing facilities for testing, modification and balancing these IR-1 centrifuges.

51. The IAEA will establish a baseline for the amount of uranium legacy from past enrichment operations that will remain in Fordow. Iran will permit the IAEA regular access, including daily as requested by the IAEA, access to the FFEP in order to monitor Iran's production of stable isotopes and the absence of undeclared nuclear material and activities at the FFEP for 15 years.

I. OTHER ASPECTS OF ENRICHMENT

52. Iran will abide by its voluntary commitments as expressed in its own long term enrichment and enrichment R&D plan to be submitted as part of the initial declaration described in Article 2 of the Additional Protocol.[1] The IAEA will confirm on an annual basis, for the duration of the plan that the nature and scope and scale of Iran's enrichment and enrichment R&D activities are in line with this plan.

53. Iran will start to install necessary infrastructure for the IR-8 at Natanz in Hall B of FEP after year 10.

54. An agreed template for describing different centrifuge types (IR-1, IR-2m, IR-4, IR-5, IR-6, IR-6s, IR-7, IR-8) and the associated definitions need to be accomplished by implementation day.

55. An agreed procedure for measuring IR-1, IR-2m and IR-4 centrifuge performance data needs to be accomplished by implementation day.

J. URANIUM STOCKS AND FUELS

[1] Iran will permit the IAEA to share the content of the enrichment and enrichment R&D plan, as submitted as part of the initial declaration, with the Joint Commission participants.

56. Iran will maintain a total enriched uranium stockpile of no more than 300 kg of up to 3.67% enriched uranium hexafluoride (or the equivalent in different chemical forms) for 15 years.

57. All enriched uranium hexafluoride in excess of 300 kg of up to 3.67% enriched UF6 (or the equivalent in different chemical forms) will be down blended to natural uranium level or be sold on the international market and delivered to the international buyer in return for natural uranium delivered to Iran. Iran will enter into a commercial contract with an entity outside Iran for the purchase and transfer of its enriched uranium stockpile in excess of 300 kg UF6 in return for natural uranium delivered to Iran. The E3/EU+3 will facilitate, where applicable, the conclusion and implementation of this contract. Iran may choose to seek to sell excess enriched uranium to the IAEA fuel bank in Kazakhstan when the fuel bank becomes operational.

58. All uranium oxide enriched to between 5% and 20% will be fabricated into fuel plates for the Tehran Research Reactor or transferred, based on a commercial transaction, outside of Iran or diluted to an enrichment level of 3.67% or less. Scrap oxide and other forms not in plates that cannot be fabricated into TRR fuel plates will be transferred, based on a commercial transaction, outside of Iran or diluted to an enrichment level of 3.67% or less. In case of future supply of 19.75% enriched uranium oxide (U3O8) for TRR fuel plates fabrication, all scrap oxide and other forms not in plates that cannot be fabricated into TRR fuel plates, containing uranium enriched to between 5% and 20%, will be transferred, based on a commercial transaction, outside of Iran or diluted to an enrichment level of 3.67% or less within 6 months of its production. Scrap plates will be transferred, based on a commercial transaction, outside Iran. The commercial transactions should be structured to return an equivalent amount of natural uranium to Iran. For 15 years, Iran will not build or operate facilities for converting fuel plates or scrap back to UF6.

59. Russian designed, fabricated and licensed fuel assemblies for use in Russian-supplied reactors in Iran do not count against the 300 kg UF6 stockpile limit. Enriched uranium in fabricated fuel assemblies from other sources outside of Iran for use in Iran's nuclear research and power reactors, including those which will be fabricated outside of Iran for the initial fuel load of the modernised Arak research reactor, which are certified by the fuel supplier and the appropriate Iranian authority to meet international standards, will not count against the 300 kg UF6 stockpile limit. The Joint Commission will establish a Technical Working Group with the goal of enabling fuel to be fabricated in Iran while adhering to the agreed stockpile parameters (300 kg of up to 3.67 % enriched UF6 or the

equivalent in different chemical forms). This Technical Working Group will also, within one year, work to develop objective technical criteria for assessing whether fabricated fuel and its intermediate products can be readily converted to UF6. Enriched uranium in fabricated fuel assemblies and its intermediate products manufactured in Iran and certified to meet international standards, including those for the modernised Arak research reactor, will not count against the 300 kg UF6 stockpile limit provided the Technical Working Group of the Joint Commission approves that such fuel assemblies and their intermediate products cannot be readily reconverted into UF6. This could for instance be achieved through impurities (e.g. burnable poisons or otherwise) contained in fuels or through the fuel being in a chemical form such that direct conversion back to UF6 would be technically difficult without dissolution and purification. The objective technical criteria will guide the approval process of the Technical Working Group. The IAEA will monitor the fuel fabrication process for any fuel produced in Iran to verify that the fuel and intermediate products comport with the fuel fabrication process that was approved by the Technical Working Group. The Joint Commission will also support assistance to Iran including through IAEA technical cooperation as appropriate, in meeting international qualification standards for nuclear fuel produced by Iran.

60. Iran will seek to enter into a commercial contract with entities outside Iran for the purchase of fuel for the TRR and enriched uranium targets. The E3/EU+3 will facilitate, as needed, the conclusion and implementation of this contract. In the case of lack of conclusion of a contract with a fuel supplier, E3/EU+3 will supply a quantity of 19.75% enriched uranium oxide (U3O8) and deliver to Iran, exclusively for the purpose of fabrication in Iran of fuel for the TRR and enriched uranium targets for the lifetime of the reactor. This 19.75% enriched uranium oxide (U3O8) will be supplied in increments no greater than approximately 5 kg and each new increment will be provided only when the previous increment of this material has been verified by the IAEA to have been mixed with aluminum to make fuel for the TRR or fabricated into enriched uranium targets. Iran will notify the E3/EU+3 within 2 year before the contingency of TRR fuel will be exhausted in order to have the uranium oxide available 6 months before the end of the 2 year period.

K. CENTRIFUGE MANUFACTURING

61. Consistent with its enrichment and enrichment R&D plan, Iran will only engage in production of centrifuges, including centrifuge rotors suitable for isotope separation or any other centrifuge components, to meet the enrichment and enrichment R&D requirements of this Annex.

62. Consistent with its plan, Iran will use the stock of IR-1 centrifuge machines in storage, which are in excess of the remaining 5060 IR-1 centrifuges in Natanz and the IR-1 centrifuges installed at Fordow, for the replacement of failed or damaged machines. Whenever during the 10 year period from the start of the implementation of the JCPOA, the level of stock of IR-1 machines falls to 500 or below, Iran may maintain this level of stock by resuming production of IR-1 machines at a rate up to the average monthly crash rate without exceeding the stock of 500.

63. Consistent with its plan, at the end of year 8, Iran will commence manufacturing of IR-6 and IR-8 centrifuges without rotors through year 10 at a rate of up to 200 centrifuges per year for each type. After year 10, Iran will produce complete centrifuges with the same rate to meet its enrichment and enrichment R&D needs. Iran will store them at Natanz in an above ground location, under IAEA continuous monitoring, until they are needed for final assembly according to the enrichment and enrichment R&D plan.

L. ADDITIONAL PROTOCOL AND MODIFIED CODE 3.1

64. Iran will notify the IAEA of provisional application of the Additional Protocol to its Safeguards Agreement in accordance with Article 17(b) of the Additional Protocol pending its entry into force, and subsequently seek ratification and entry into force, consistent with the respective roles of the President and the Majlis (Parliament).

65. Iran will notify the IAEA that it will fully implement the Modified Code 3.1 of the Subsidiary Arrangement to Iran's Safeguards Agreement as long as the Safeguards Agreement remains in force.

M. PAST AND PRESENT ISSUES OF CONCERN

66. Iran will complete all activities as set out in paragraphs 2, 4, 5, and 6 of the "Roadmap for Clarification of Past and Present Outstanding Issues", as verified by the IAEA in its regular updates by the Director General of the IAEA on the implementation of this Roadmap.

N. MODERN TECHNOLOGIES AND LONG TERM PRESENCE OF IAEA

67. For the purpose of increasing the efficiency of monitoring for this JCPOA, for 15 years or longer, for the specified verification measures:

67.1. Iran will permit the IAEA the use of on-line enrichment measurement and electronic seals which communicate their status within nuclear sites to IAEA inspectors, as well as other IAEA approved and certified modern technologies in line with internationally accepted IAEA practice. Iran will facilitate automated collection of IAEA measurement recordings registered by installed measurement devices and sending to IAEA working space in individual nuclear sites.

67.2. Iran will make the necessary arrangements to allow for a long-term IAEA presence, including issuing long-term visas, as well as providing proper working space at nuclear sites and, with best efforts, at locations near nuclear sites in Iran for the designated IAEA inspectors for working and keeping necessary equipment.

67.3. Iran will increase the number of designated IAEA inspectors to the range of 130-150 within 9 months from the date of the implementation of the JCPOA, and will generally allow the designation of inspectors from nations that have diplomatic relations with Iran, consistent with its laws and regulations.

O. TRANSPARENCY RELATED TO URANIUM ORE CONCENTRATE (UOC)

68. Iran will permit the IAEA to monitor, through agreed measures that will include containment and surveillance measures, for 25 years, that all uranium ore concentrate produced in Iran or obtained from any other source, is transferred to the uranium conversion facility (UCF) in Esfahan or to any other future uranium conversion facility which Iran might decide to build in Iran within this period.

69. Iran will provide the IAEA with all necessary information such that the IAEA will be able to verify the production of the uranium ore concentrate and the inventory of uranium ore concentrate produced in Iran or obtained from any other source for 25 years.

P. TRANSPARENCY RELATED TO ENRICHMENT

70. For 15 years, Iran will permit the IAEA to implement continuous monitoring, including through containment and surveillance measures, as necessary, to verify that stored centrifuges and infrastructure remain in storage, and are only used to replace failed or damaged centrifuges, as specified in this Annex.

71. Iran will permit the IAEA regular access, including daily access as requested by the IAEA, to relevant buildings at Natanz, including all parts of the FEP and PFEP, for 15 years.

72. For 15 years, the Natanz enrichment site will be the sole location for all of Iran's uranium enrichment related activities including safeguarded R&D.

73. Iran intends to apply nuclear export policies and practices in line with the internationally established standards for the export of nuclear material, equipment and technology. For 15 years, Iran will only engage, including through export of any enrichment or enrichment related equipment and technology, with any other country, or with any foreign entity in enrichment or enrichment related activities, including related research and development activities, following approval by the Joint Commission.

Q. ACCESS

74. Requests for access pursuant to provisions of this JCPOA will be made in good faith, with due observance of the sovereign rights of Iran, and kept to the minimum necessary to effectively implement the verification responsibilities under this JCPOA. In line with normal international safeguards practice, such requests will not be aimed at interfering with Iranian military or other national security activities, but will be exclusively for resolving concerns regarding fulfilment of the JCPOA commitments and Iran's other non-proliferation and safeguards obligations. The following procedures are for the purpose of JCPOA implementation between the E3/EU+3 and Iran and are without prejudice to the safeguards agreement and the Additional Protocol thereto. In implementing this procedure as well as other transparency measures, the IAEA will be requested to take every precaution to protect commercial, technological and industrial secrets as well as other confidential information coming to its knowledge.

75. In furtherance of implementation of the JCPOA, if the IAEA has concerns regarding undeclared nuclear materials or activities, or activities inconsistent with the JCPOA, at locations that have not been declared under the comprehensive safeguards agreement or Additional Protocol, the IAEA will provide Iran the basis for such concerns and request clarification.

76. If Iran's explanations do not resolve the IAEA's concerns, the Agency may request access to such locations for the sole reason to verify the absence of undeclared nuclear materials and activities or activities inconsistent with the JCPOA at such locations. The IAEA will provide Iran the reasons for access in writing and will make available relevant information.

77. Iran may propose to the IAEA alternative means of resolving the IAEA's concerns that enable the IAEA to verify the absence of undeclared nuclear materials and activities or activities inconsistent with the JCPOA at the location in question, which should be given due and prompt consideration.

78. If the absence of undeclared nuclear materials and activities or activities inconsistent with the JCPOA cannot be verified after the implementation of the alternative arrangements agreed by Iran and the IAEA, or if the two sides are unable to reach satisfactory arrangements to verify the absence of undeclared nuclear materials and activities or activities inconsistent with the JCPOA at the specified locations within 14 days of the IAEA's original request for access, Iran, in consultation with the members of the Joint Commission, would resolve the IAEA's concerns through necessary means agreed between Iran and the IAEA. In the absence of an agreement, the members of the Joint Commission, by consensus

or by a vote of 5 or more of its 8 members, would advise on the necessary means to resolve the IAEA's concerns. The process of consultation with, and any action by, the members of the Joint Commission would not exceed 7 days, and Iran would implement the necessary means within 3 additional days.

R. CENTRIFUGE COMPONENT MANUFACTURING TRANSPARENCY

79. Iran and the IAEA will take the necessary steps for containment and surveillance on centrifuge rotor tubes and bellows for 20 years.

80. In this context:

80.1. Iran will provide the IAEA with an initial inventory of all existing centrifuge rotor tubes and bellows and subsequent reports on changes in such inventory and will permit the IAEA to verify the inventory by item counting and numbering, and through containment and surveillance, of all rotor tubes and bellows, including in all existing and newly produced centrifuges.

80.2. Iran will declare all locations and equipment, namely flow-forming machines, filament-winding machines and mandrels that are used for production of centrifuge rotor tubes or bellows, and will permit the IAEA to implement continuous monitoring, including through containment and surveillance on this equipment, to verify that this equipment is being used to manufacture centrifuges only for the activities specified in this JCPOA.

S. OTHER URANIUM ISOTOPE SEPARATION ACTIVITIES

81. For 10 years, Iran's uranium isotope separation-related research and development or production activities will be exclusively based on gaseous centrifuge technology.[2] Iran will permit IAEA access to verify that uranium isotope separation production and R&D activities are consistent with this Annex.

[2] For the purpose of this Annex, non-gaseous centrifuge uranium isotope separation-related research and development or production will include laser isotope separation systems, electromagnetic isotope separation systems, chemical exchange systems, gaseous diffusion systems, vortex and aerodynamic systems, and other such processes that separate uranium isotopes.

T. ACTIVITIES WHICH COULD CONTRIBUTE TO THE DESIGN AND DEVELOPMENT OF A NUCLEAR EXPLOSIVE DEVICE

82. Iran will not engage in the following activities which could contribute to the development of a nuclear explosive device:

82.1. Designing, developing, acquiring, or using computer models to simulate nuclear explosive devices.

82.2. Designing, developing, fabricating, acquiring, or using multi-point explosive detonation systems suitable for a nuclear explosive device, unless approved by the Joint Commission for non-nuclear purposes and subject to monitoring.

82.3. Designing, developing, fabricating, acquiring, or using explosive diagnostic systems (streak cameras, framing cameras and flash x-ray cameras) suitable for the development of a nuclear explosive device, unless approved by the Joint Commission for non-nuclear purposes and subject to monitoring.

82.4. Designing, developing, fabricating, acquiring, or using explosively driven neutron sources or specialized materials for explosively driven neutron sources.

Attachment: Arak conceptual design

Fundamental Principles:

- Maximize use of the current infrastructure of original design of Arak research reactor, designated by the IAEA as IR-40, according to their respective ratings.

- Modernizing of the original design in order to be a multi-purpose research reactor comprising radio-isotope production, structural materials and fuel (pins and assembly prototypes) testing and able to conduct other neutronic experiments which demand high neutron fluxes (more than 10^{14}).

- Using heavy water as coolant, moderator and reflector. Light water would be utilized as an annular ring around the compact new core for safety reasons if necessary.

- Around 78 fuel assemblies in a tight hexagonal grid spacing with the following preliminary characteristics will be loaded.

- Up to 3.67 percent enriched UO_2, in the improved assembly design, will be used as fuel.

- Power will not exceed to 20 MWth.

- Adding different types of beam tubes to the existing beam tubes which being extended to the edge of the new compact core.

- Having one central channel in the center of the new core with passive cooling system for the purpose of structural materials and fuel pins and assembly prototypes testing with neutron flux beyond $2 \bullet 10^{14}$, twelve in-core irradiation channels (IIC) inside the core and twelve lateral irradiation chennals (LIC) just next to the outer ring of fuel assemblies.

- The location of the in-core and lateral irradiation channels should be designed and fixed to meet the best anticipated performances.

- Consistent with relevant section of Annex 1, sibsidiary laboratories are part of the modernization project of the Arak Research Reactor. In Addition, Annex III reinforce design and construction of subsidiary laboratoties.

- The highest tolerable pressure for the first and second loop is 0.33 Mpa (at the interance of the reactor pit).

- The highest possible flow rate for coolant is 610 kg/s at the pressure of 0.33 MPa in the main piping system and 42 Kg/sec for Moderator with the same conditions.

Preliminary Characteristics:

Core Parameters	**Values**
Power (MW)	20
Number of fuel assemblies	~ 78
Active length (cm)	~ 110
Lattice configuration	Hexagonal
Fuel pellets Material	UO_2
Fuel enrichment level	Up to 3.67 %
Clad material	Zr Alloys
Burnable poison	Yes, if necessary
Lattice pitch (cm)	~ 11
Coolant medium	D_2O
Moderator medium	D_2O
Reflector medium	D_2O
Reflector thickness (cm)	~ 50
Purity of D2O	~ 99.8%
Mass of D2O (mtons)	~ 60-70
Yearly makeup	Yes
K_{eff}	< 1.25
Core Excess reactivity (pcm)	< 20000
Cycle length (days) approximatly	~ 250
^{239}Pu at EoC (g)	~ 850
^{239}Pu purity at EoC	~ 78%
^{235}U consumption	~ 60%
Maximum Thermal Flux , E<0.625ev	~ $3 \bullet 10^{14}$
Maximum Fast Flux, E>0.625ev	~ $1 \bullet 10^{14}$
Minimum Thermal Flux , E<0.625ev	~ $1 \bullet 10^{14}$
Minimum Fast Flux, E>0.625ev	~ $1 \bullet 10^{14}$
Fluid velocity in channels (m/s)	~ 3.8
Channel mass flow rate (kg/s)	~ 2.4
Working pressure (MPa)	0.33
Fluid inlet temperature (^oC)	~ 47
Fluid outlet temperature (^oC)	~ 78
Core material	Mainly S.S. 304
Core wall Thichness (mm)	~ 30
Fuel Pellet Diameter (cm)	~ 0.65
Inner Clad Diameter (cm)	~ 0.67
Outer Clad Diameter (cm)	~ 0.8
Number of pins per assembly	12
Mass of UO2 in full core load (Kg)	~ 350
Core diameter (cm)	~ 240