

Nuclear Development

Beneficial Uses and Production of Isotopes

2000 Update

NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

TABLE OF CONTENTS

FOREWORD.....	3
EXECUTIVE SUMMARY.....	5
1. INTRODUCTION.....	11
1.1 Background.....	11
1.2 Objectives and scope.....	11
1.3 Working method.....	12
2. ISOTOPE USES.....	13
2.1 Medical applications.....	13
2.1.1 Nuclear diagnostic imaging.....	13
2.1.1.1 Gamma imaging.....	14
2.1.1.2 Positron Emission Tomography (PET).....	15
2.1.1.3 Bone density measurement.....	15
2.1.1.4 Gastric Ulcer detection.....	15
2.1.2 Radioimmunoassay.....	16
2.1.3 Radiotherapy with radiopharmaceuticals.....	16
2.1.3.1 Therapy applications.....	16
2.1.3.2 Palliative care.....	16
2.1.4 Radiotherapy with sealed sources.....	17
2.1.4.1 Remotely controlled cobalt therapy.....	17
2.1.4.2 Brachytherapy.....	17
2.1.5 Irradiation of blood for transfusion.....	17
2.2 Industrial applications.....	18
2.2.1 Nucleonic instrumentation.....	19
2.2.2 Irradiation and radiation processing.....	20
2.2.3 Radioactive tracers.....	21
2.2.4 Non destructive testing.....	21
2.2.5 Other industrial uses of radioactive isotopes.....	22
2.3 Scientific/research applications.....	22
2.3.1 Research on materials.....	23
2.3.2 Research in the field of industrial processes.....	23
2.3.3 Research in the field of environmental protection.....	23
2.3.4 Medical research.....	24
2.3.5 Biotechnologies.....	24
2.4 Stable isotopes.....	25
2.4.1 Medical applications.....	25
2.4.2 Industrial applications.....	28
2.4.3 Scientific/research applications.....	28

3.	ISOTOPE PRODUCTION.....	29
3.1	Reactors.....	31
3.1.1	Research reactors.....	31
3.1.2	Nuclear power plants.....	34
3.2	Accelerators.....	34
3.2.1	Accelerators dedicated to medical radioisotope production.....	34
3.2.1.1	Cyclotrons producing isotopes for medical applications.....	34
3.2.1.2	Cyclotrons for specialised applications.....	35
3.2.1.3	Cyclotrons producing isotopes for PET applications.....	36
3.2.2	Accelerators not dedicated to medical isotope production.....	37
3.3	Radioactive isotope separation.....	37
3.3.1	Separation of isotopes from fission products.....	37
3.3.2	Separation of transuranium elements and alpha emitters.....	38
3.4	Stable isotope production.....	38
3.4.1	Heavy stable isotopes.....	39
3.4.2	Light stable isotopes.....	40
4.	TRENDS IN ISOTOPE USES AND PRODUCTION.....	41
4.1	Trends in isotope uses.....	41
4.2	Trends in isotope production.....	43
5.	FINDINGS, CONCLUSIONS AND RECOMMENDATIONS.....	45
5.1	Findings.....	45
5.1.1	Isotope uses.....	45
5.1.2	Isotope production.....	46
5.1.3	Role of governments.....	46
5.1.4	Role of international exchanges.....	47
5.1.5	Costs and prices.....	47
5.2	Conclusions.....	47
5.3	Recommendations.....	48
Annex 1	Bibliography.....	51
Annex 2	List of members of the Group.....	53
Annex 3	Major radioisotopes produced by reactors and accelerators.....	55
Annex 4	Countries and regional groupings.....	57
Annex 5	Isotope production in OECD countries.....	59
Annex 6	Geographical distribution of research reactors producing isotopes.....	61
Annex 7	Geographical distribution of accelerators producing isotopes.....	65
Annex 8	Questionnaires.....	73