NO.: **86-4R3** DATE: May 24, 1994

SUBJECT: **Scientific Research and Experimental Development**

This circular replaces and cancels Information Circular 86-4R2, dated August 29, 1988.

Contents

1 Introduction

1.1 The purpose of these technical guidelines is to clarify what constitutes scientific research and experimental development according to the Income Tax Regulations, as set out in subsection 2900(1) of the Regulations.

1.2 Part 2 of this circular provides the key to identifying eligible scientific research and experimental development activities in all areas specified in subsection 2900(1) of the Regulations: i.e., basic research, applied research, and experimental development.

1.3 Parts 3 to 7 of this circular further clarify the technical aspects of our interpretation of subsection 2900(1) of the Regulations. They also outline the key characteristics of eligible versus ineligible activities as follows:

Part 3 – Requirements for scientific and technical content and documentation

Part 4 – Characteristics of experimental development

Part 5 – Identifying eligible activities associated with collecting data

Part 6 – Identifying eligible activities in the fields of computer science and associated technologies

Part 7 – Determining when an experimental development project is complete

1.4 The term “experimental development” was added to the description of the relevant sections of the *Income Tax Act* in May 1985. These sections now refer to “scientific research and experimental development” rather than simply to “scientific research.” The May 1985 Budget Papers issued by the Department of Finance Canada stated that the phrase “experimental development” was meant to confirm that “projects involving only routine engineering or routine development” would be excluded. “Experimental development” is thus set out as an aspect of the more general concept of “development.” Only development activities associated with “experimental development” are eligible.

1.5 **This circular examines only the technical issues** involved in characterizing eligible scientific research and experimental development activities. Judgements on technical matters require the opinions of scientists, engineers, and other technical experts. Therefore, we have directed this circular to technically trained individuals who have to identify activities that are eligible. The current version of IT-151, *Scientific Research and Experimental Development Expenditures*, explains how to identify qualifying expenditures.

1.6 Part 8 deals with administrative matters, and is followed by an index and a glossary.

2 General Considerations in Identifying Eligible Activities

2.1 Ultimately, the question of what constitutes scientific research and experimental development for purposes of the *Income Tax Act* can only be resolved by referring to the facts of each case.

2.2 Statutory and general definitions

2.3 Science is a branch of study in which phenomena are observed and classified and, usually, in which quantitative and qualitative relations are formulated and verified. Subsection 2900(1) of the Regulations defines scientific research and experimental development (SR&ED) as requiring a "systematic investigation or search carried out in a field of science or technology through experiment or analysis." Here, technology refers to the systematic study of the application of scientific knowledge to industrial processes or product development.

2.4 Subsection 2900(1) of the Regulations goes on to define the following categories of scientific research and experimental development:

(a) basic research, namely, work undertaken to advance scientific knowledge without a specific practical application in view;

(b) applied research, namely, work undertaken to advance scientific knowledge with a specific practical application in view;

*****(c) experimental development, namely, work undertaken to achieve technological advances for the purpose of creating new, or improving existing, materials, devices, products, or processes, including incremental improvements thereto, or

*****(d) work with respect to engineering, design, operations research, mathematical analysis, computer programming, data collection, testing, and psychological research, where such work is commensurate with the needs, and directly in support of the work described in paragraphs (a), (b), or (c) above.

***Note:** Changes to part c) and the addition of part d) above to the definition of SR&ED reflect the draft amendment to subsection 2900(1) of the Regulations announced in December 1992, which has yet to be promulgated.

2.5 Subsection 2900(1) of the Regulations further states that SR&ED does not include work for:

- market research or sales promotion;
- quality control or routine testing of materials, devices, products, or processes;
- research in the social sciences or the humanities;
- prospecting, exploring, or drilling for or producing minerals, petroleum, or natural gas;
- the commercial production of a new or improved material, device, or product, or the commercial use of a new or improved process;
- style changes; and
- routine data collection.

2.6 Major issues

2.7 Two major issues in defining scientific research and experimental development are:

- how to distinguish between eligible activities that advance scientific or technological knowledge and exclude activities that are "routine engineering or routine development"; and
- how to distinguish eligible experimental development activities from ineligible commercial activities.

2.8 We determine whether an activity is eligible or ineligible under subsection 2900(1) of the Regulations solely by examining the nature and characteristics of the activity itself.

In other words, it is not the overall purpose of the activity or program, but rather what is actually occurring at a technical level that is relevant. This is an important point because the intent of all development in a business context is to produce viable products or processes. Thus the key point relating to the Act and Regulations is whether or not an activity has the characteristics of an eligible scientific research and experimental development activity, and not the overall goals in a commercial sense.

2.9 General criteria

2.10 Essential tests that must be met before any activity can be considered scientific research and experimental development include the criterion of scientific or technological advancement; the criterion of scientific or technological uncertainty; and the criterion of scientific and technical content.

2.10.1 The **criterion of scientific or technological advancement** is as follows:

- The search carried out in the scientific research and experimental development activity must generate information that advances our understanding of scientific relations or technologies. In a business context, this means that when a new or improved product or process is created, it must embody a scientific or technological advancement in order to be eligible.

2.10.2 The **criterion of scientific or technological uncertainty** is as follows:

- Whether or not a given result or objective can be achieved, and/or how to achieve it, is not known or determined on the basis of generally available scientific or technological knowledge or experience. This criterion implies that we cannot know the outcome of a project, or the route by which it will be carried out without removing the technological or scientific uncertainty through a program of scientific research or experimental development. Specifically, scientific or technological uncertainty may occur in either of two ways:
  - it may be uncertain whether the goals can be achieved at all; or

  - the taxpayer may be fairly confident that the goals can be achieved, but may be uncertain which of several alternatives (i.e., paths, routes, approaches, equipment configurations, system architectures, circuit techniques, etc.) will either work at all, or be feasible to meet the desired specifications or cost targets, or both of these.

- The scientific or technological uncertainty, rather than the economic or financial risk, is important in characterizing scientific research and experimental development — and, hence, eligible activities.
- Sometimes there is little doubt that a product or process can be produced to meet technological objectives when cost targets are no object. In commercial reality, however, a reasonable cost target is always an objective, and attempting to achieve a particular cost target can at times create a technological challenge which needs to be resolved. A technological uncertainty may thus arise that is imposed by economic considerations. Otherwise, the more general question of the commercial viability of the product or process is not relevant to whether or not a technological uncertainty is present and, hence, to whether a project is eligible or ineligible.
- This criterion applies equally to work on new or existing processes or products. The description of technological uncertainty contained in this subsection applies wherever the text of this circular refers to the criterion.

2.10.3 The **criterion of scientific and technical content** is as follows:

- The scientific research and experimental development activity must incorporate a systematic investigation going from hypothesis formulation, through testing by experimentation or analysis, to the statement of logical conclusions. Such experimentation can include work on the evolution of prototypes or models. In a business context, this means that the objectives of the scientific research and experimental development projects must be clearly stated at an early stage in the project's evolution. In addition, the method of experimentation or analysis by which the scientific or technological uncertainties are to be addressed must be clearly set out. Finally, the results of the succeeding scientific research and experimental development efforts have to be properly identified. The need for a systematic program of investigation does not preclude ideas that result from intuitive processes. Such ideas are hypotheses, however, and must still be tested through a systematic program before they can be accepted.
- Qualified personnel having relevant experience in science, technology, or engineering are responsible for directing or performing the work.

2.11 Application of criteria

The three criteria of IC 86-4R3 must be applied within the context of the taxpayer’s business environment.

Scientific research and experimental development varies in content as well as in the complexity of the technology in a given field. The technical uncertainties encountered by one taxpayer may well be looked upon as facts easily obtained by another. The judgement as to eligibility should be made within the context and environment of a single company and its field of business. Specifically, the activities undertaken to resolve technical uncertainties are eligible if the taxpayer cannot obtain the solutions through commonly available sources of knowledge and experience in the business context of the firm. We expect that any firm claiming expenditures for scientific research and experimental development activities will have or will access the expertise necessary to carry out a viable program.

2.12 Not all the work elements in a scientific research and experimental development activity will involve scientific or technological uncertainty. To conform to the spirit of the legislation, however, the overall activity must contain scientific or technological uncertainties. That is, the search for a meaningful advance in the body of scientific or technological knowledge should be present as a guiding element in every eligible project. This requirement is satisfied whether or not the activity is successful. In other words, determining that a hypothesis is incorrect also represents a scientific or technological advance.

2.13 The definition of “experimental development” in subsection 2900(1) of the Regulations requires that work be undertaken to achieve technological advancement when creating new, or when slightly improving existing materials, devices, products, or processes. For an experimental development activity to be eligible in terms of scientific research and experimental development, it must conform to the spirit of the legislation; that is, it must seek to advance the taxpayer's technological knowledge base. The technological advance achieved has only to be slight.

Achieving a technological advance would require removing the element of technological uncertainty through a process of systematic investigation. This may occur when technologies established in one field are introduced into products or processes in another field of technology. The improvement of existing technologies or methodologies using well-established “routine engineering or routine development” would be ineligible if the outcome is predictable. A straightforward design development, for example, is not an eligible activity. However, as noted earlier (2.4d), if the “routine” engineering or “routine” development activity is carried out in support of an eligible experimental development project, then the activity is eligible.

2.14 In summary: If the primary objective is to make further technological advances in the product or process, then the work meets the criteria for experimental development. If, on the other hand, the technological character of the product or process is substantially set, and the primary objective is to develop markets, to do preproduction activity, or to get a production or control system working smoothly, then the work no longer meets the criteria. However, if technological

uncertainty exists under these circumstances, then work on studies to resolve the technological problems may still be eligible. This is amplified in later sections.

3 Requirements for Scientific and Technical Content and Documentation

3.1 It is usual in scientific research and experimental development to expect that a planned approach to the project will be formulated; that is, a hypothesis will be advanced, and a systematic series of experiments or analyses will be planned to test the hypothesis.

Each project should be documented showing clearly why each major element is required, and how it fits into the project as a whole. To build on the results of testing in a systematic way requires the organized documentation of work undertaken in the elements of experimentation or analysis. The systematic progression of the activity is built on analyzing the results from step to step — the "systematic investigation or search" called for in subsection 2900(1) of the Regulations – and is the essence of the experimental method. If claims for scientific research and experimental development are to be defended, it is important for a firm to maintain dated documents of the original technological goals of the project, the progress of the work and how it has been carried out, and the project's conclusions.

We also expect that the indicators or measures to be used to determine if the technological objectives of the project are met will be identified when forming the concepts for the program. These measures should also be documented at the early stages of the program. Failure to have such documentation indicates the absence of a systematic program of scientific research or experimental development. Note that failure to achieve the objectives does not negate the validity of the experimental development program.

4 Characteristics of Experimental Development

4.1 Eligible activities must generate information that advances our understanding of scientific relations or technologies. A technological advance is incorporating, by means of experimental development, a characteristic or capability not previously existing or available in standard practice, into a new or existing process or product that enhances a product's performance. Novelty, uniqueness, or innovation alone do not indicate a technological advance.

4.2 A key distinction between eligible and ineligible activities is the difference between experimental development and development based solely on "standard practice" in established fields of engineering or technology. Standard practice refers to directly adapting a known engineering or technological practice to a new situation when there is a high degree of certainty that the known technology or practice will achieve the desired objective. Specifically, projects predominantly using "standard practice" are based on commonly available experience, and development activities based on it generally are ineligible. When "standard practice" is used to support an eligible experimental development activity, the associated activities are of course eligible. Ultimately, the final judgement of what is or is not standard practice in a given field of technology can only be made by specialists familiar with that field.

4.3 Adapting a known technology or practice to new situations is ineligible when the routes for the progression of work that will lead to successful solutions to a technological or engineering problem can be identified in standard practice. In other words, if the project involves directly adapting a known technology to a new situation, when it is reasonably certain that the approach will work, it is ineligible. If a technological uncertainty is present, however, then experimental development will occur, and an experimentally based study will be required which goes beyond standard practice. Essentially, the presence of a technological uncertainty puts the project into the realm of experimental development when solutions cannot be based on standard practice alone.

4.4 A claim for qualifying expenditures should clearly explain all departures from standard practice in the experimental development activity.

4.5 In experimental development, the outcome is uncertain because the present level of technology (state-of-the-art) is insufficient, or because the compatibility of new combinations of technologies is uncertain. Resolving the technological uncertainty will result in a technological advance, and it is the work on resolving these uncertainties that characterizes an eligible experimental development activity. Neither the failure nor the success of a project proves that technological uncertainty exists. It is the reason why the failure or success occurs that is important. Failure arising because of inexperience, improper application of standard practice, lack of information, or financial constraints, does not in itself indicate that a technological risk is present.

4.6 When complex combinations of technology occur, the criterion distinguishing between eligible experimental development and ineligible development is again the element of technological uncertainty. If a complex engineering activity results in a new product or process, the development of which was the almost certain outcome of applying a progression of well-known techniques, it cannot be classified as an eligible experimental development activity. This equates to assembling a jigsaw puzzle where each of the pieces is well-defined, and it can be expected that, with a given amount of effort and reasonable technical skills, the final product can be assembled.

4.7 In any experimental development program, there is the usual progression of activities from the conception of an

idea through to full-scale production. There are two types of activities that can be associated with any component in this progression:

(a) those based solely on standard practice (e.g., minor modifications, troubleshooting, debugging, etc.), when the outcome is predictable and thus the activities are ineligible; and

(b) those requiring technological advancement (new or improved product or process characteristics), which are eligible.

The central problem in any multifaceted experimental development program is to identify which components are eligible, and which are not (i.e., which belong in either (a) or (b) above). Any point along the entire process from initial conception to the time when commercial production begins has the potential to contain an eligible activity of experimental development.

4.8 Work on combining standard technologies, devices, and/or processes is eligible if non-trivial combinations of established (well-known) technologies and principles for their integration carry a major element of technological uncertainty; this may be called a "system uncertainty." If the technological specifications or objectives to resolve the "system uncertainty" are such that the basic design of the underlying technologies must be changed to achieve the integration, the current costs of the overall project may qualify. More often, it will be necessary to separate those activities which are eligible from those which are not. In such situations, a central problem is to determine which work relates to the eligible activity (i.e., which routine engineering activities are carried out in "support" of the requirements of the eligible activity), and which do not.

When the specifications for components requiring advances in technology do not significantly affect the design requirements of other components in complex projects, only individual studies carried out to meet the advanced design requirements of the activity are eligible. When advanced technological specifications require redesigning closely related components, then the activities associated with redesigning the associated components are eligible. These considerations apply to the assessment of any custom design project (customization), pilot plants which have commercial potential, and prototypes which are ultimately sold.

4.9 When it is necessary to distinguish between eligible and ineligible activities in complex projects, accounting procedures have to be established to reflect this requirement.

5 Identifying Eligible Activities Associated With Collecting Data

5.1 For activities associated with collecting or monitoring data to qualify, the data must be collected directly for the purpose of resolving a scientific or technological uncertainty associated with an eligible activity. Often, the analysis of large collections of survey data can be used to resolve a technological uncertainty, even if the data are not specifically or directly collected for the needs of the eligible scientific research or experimental development activity. In these cases, only the activities associated with analyzing the data would be eligible, not the actual data collection. For the activities to be eligible, a systematic approach to collecting (study design) must be followed which provides only the amount of data needed for the specific scientific or technological uncertainty being studied. In other words, systematic study design will be focussed on providing the amount of information appropriate to resolving the issue. Specifically, the dimensions or size of data collections, for which the collection costs qualify, should agree with the requirements that can be determined from well-established statistical considerations for developing good experimental designs.

5.2 The above should not be taken as excluding completely the practice of using testing protocols that do not strictly follow statistical considerations, if such tests are needed to resolve a specific scientific or technological uncertainty. Nevertheless, collecting excessive amounts of data is generally not consistent with a systematic investigation, and would generally be grounds for questioning the eligibility of the collection activities (but not for questioning the activities associated with analyzing the data).

5.3 Often, a qualifying scientific research and experimental development activity is carried out together with environmental, geological, or hydrological surveys, regular exploration, or other generally ineligible activities. The collection costs for the ineligible activity that would usually be incurred still will not qualify, even if an experimental development project has been attached to such surveys or exploration activities or testing.

However, in these cases, it would be appropriate to consider, as a qualifying cost, the added current expenditures arising from including the research program. For example, data could be collected to test a new approach for collecting data. To verify this new approach, it would be appropriate to incorporate this testing into a program for regular collection or monitoring; only the added costs for testing the new system would qualify.

5.4 When a hypothesis about a scientific or technological uncertainty is tested through projects involving experimentation, that experimentation will involve data collection. Further, we regard the data collection involved in all such experimentation as being an eligible activity when the size of the data collection matches the needs of the study. While the specific parameters being measured may be commonly encountered quality or processing parameters, we will consider their measurement to be eligible when the experiment directly conforms to the needs of the experimental activity. This is in direct contrast with the type of data collection that occurs in everyday commercial operations, where the primary objective of such analyses is product or process monitoring to demonstrate adherence to

specifications, supervision of processes, and control of finished product characteristics. We do not consider these last to be qualifying expenditures.

5.5 None of the costs for collecting data needed in the usual course of managerial duties — such as for quality control, inventory control, cost control, delivery control, and process or product monitoring in commercial situations — qualify.

5.6 Costs for collecting data to be used as baseline data or to support developments based solely on standard engineering or technological practice do not qualify. Such data generally are of the following type:

(a) data on the physical properties of sites, such as hydrological, geological, and geophysical data used by architects, engineers, agricultural technologists, and geophysicists in the usual course of their professional tasks, when no eligible scientific research and experimental development activity is present; or

(b) descriptive data such as population census collections or descriptions of the flora and fauna in a region, used as baseline data, or similar collections of hydrological, geological, or geophysical data.

However, in some fields of basic or applied science, purely descriptive data are collected in projects that seek to make meaningful advances in the knowledge base of these fields. For such projects to be considered as eligible activities in scientific research and experimental development, the project objectives would have to be recognized as constituting the search for a significant advancement by a professional research scientist working in the field.

5.7 The collection of data using repetitive, standardized procedures or protocols, seeking to establish whether parameters are within the usual boundaries, characterizes much routine testing. Examples are regular clinical testing for medical diagnostic purposes, or the monitoring of commercial production processes. The costs of collecting such data do not qualify. Of course, the costs for using the same or similar experimental protocols or procedures may qualify when they meet the requirements of eligible scientific research and experimental development activities.

6 Criteria for Identifying Eligible Activities in Computer Science and Associated Technologies

The following addresses the problem of what is an advance directly in computer science and associated technologies. Activities such as programming and coding, that are commensurate with the needs and directly in support of an eligible project in other fields are eligible activities.

6.1 Computer science is a discipline that draws upon advances made in numerous other fields of science, particularly electrical and electronic engineering, and mathematics. It is a discipline where advances in hardware and software arise from the unique application of combinations of technologies and ideas to developing methods of manipulating, structuring, and communicating data through computers.

6.2 It is how the data are manipulated, organized, or communicated, and whether or not the methodology in question represents an advance over the technology of data manipulation or communication commonly available in the industry concerned, that is important in determining what is an eligible activity in this field. It is not the nature or purpose of the data being manipulated or communicated that is at issue.

6.3 As noted, novelty or innovation alone in the product or process does not demonstrate that an eligible activity exists. It is how the novelty arises (i.e., whether or not it arises from the resolving technological uncertainties) which is important. In this respect, although it can be said that every new or improved computer program is unique in some aspect, to be eligible under subsection 2900(1) of the Regulations, a new or improved program must represent a scientific or technological advance. An effort to achieve such an advance will result in a significant departure from the usual established practice in business. It results from a situation when there is a technological uncertainty about the method of achievement of, or the actual achievement of, the advanced technological objective.

6.4 It is important to realize that uncertainties can also arise from non-technical sources, such as the failure to use available information, lack of programming knowledge (incorrect application of existing principles), or lack of technical management expertise (such as underestimating difficulties in downsizing, language translations, or hardware interfacing, or the incorrect specification of technological requirements). A technological uncertainty, on the other hand, arises when the solution is not readily apparent to someone familiar with the basic stock of commonly used knowledge and techniques within the business context of the firm. Only activities aimed at resolving technological uncertainties are eligible.

6.5 As concerns programming associated with application software, custom software, data management, and numerical analysis, a common component of eligible activities is often the development of new, advanced algorithms (procedures and subroutines), or the use of algorithms new to a particular area of business to resolve a technical uncertainty in that area of business.

6.6 In general, we expect that, in multifaceted software projects, while some aspects of the project may qualify, others will not. In other words, only those aspects or components that attempt to resolve a technological uncertainty will qualify.

Other aspects of developing the overall software program would usually be ineligible unless the characteristics of the advance create, or leave remaining, major uncertainties about

whether the overall technological objectives of the project can be achieved. In these cases, the work associated with the overall project may be eligible.

However, if resolving the technological uncertainty later requires modifying associated established components, then work on those modifications will be eligible. Additional aspects of the integration generally would not be eligible. In such cases, segregating activities (with documentation) among the project components would be appropriate.

6.7 Customizing software involves changes to meet the individual requirements of a user. While such changes often require a significant amount of coding and other work, customization assignments are usually in the nature of "fine-tuning" or maintenance. These activities are generally ineligible because technological uncertainties usually are not involved. However, if an activity required to resolve a technological uncertainty is identified, then the costs associated with this work will qualify.

6.8 Work on improving or advancing the user interface in computer systems, including developing technological objectives for the user interface, can be an integral part of eligible experimental development activities. Such activities may include research on specifying user requirements. They are eligible when carried out directly in support of the needs of an activity that itself is established as eligible. All market research activities, including those directed at market development and market verification, general market identification, market demonstration, market preference, and development of customer acceptance, are ineligible.

6.9 Regarding software, the cutoff for experimental development is the point when the product or process can be or is used in routine operations. If problems should emerge in the commercial use of the product, and resolving them contains technological uncertainties, then it should be considered a new project for purposes of subsection 2900(1) of the Regulations. The qualifying activities in the new project are only those that are needed to resolve the newly encountered technological uncertainty, and not the costs for finding out that a problem exists once a product is used in routine operations. Similarly, a customer may find defects in established products. Work undertaken in correcting such defects are eligible activities only if a new technological uncertainty is identified and addressed.

6.10 The following are comments on what constitutes advances in specific areas of computer science and associated technologies. They are intended to provide guidance, but they are not intended to be definitive or to preclude work in other areas. Obviously, what constitutes an advance in any area still must be judged in light of the "state-of-the-art" in that area at the time when the project is undertaken.

(a) **Theoretical computer science** deals with what is computing, what can or cannot be done with computing, and how it can be done. This includes, for example, complexity analysis and language theory. Generally, the technological or scientific advances in this area produce new theorems and algorithms. As in any scientific or technological endeavour where uncertainty exists, some eligible activities are expected to have negative results.

(b) **Operating systems** provide services in a computer system for (i) managing resources such as files, processes, memory, and time; and (ii) managing interfaces such as those with the user, with machines, and with communications systems. Technological advances consist in a technological improvement in (i) or (ii); a truly new operating system; or converting an operating system to a significantly different hardware environment. In disputed cases, computer scientists with experience in the particular area in question need to assess what is "significantly different."

(c) Technological advances in **programming languages** are new languages; significant extensions to an existing language; and new or significantly different language translators.

(d) **Applications software** (including customized software) involves developing software systems for particular uses. In addition to the situations previously outlined, technological advances may occur when a development represents a significant technological step forward (e.g., new combinations of established computer program components or known programming principles), provided that this integration requires resolving technological uncertainties.

(e) **Data management** involves the definition, organization, accessing, manipulation, and storage of data within a computer system. This includes what is generally called databases, data structures, and data algorithms. Technological advances include developing algorithms to achieve significantly better basic operations (e.g., retrievals from a database); new or enhanced query languages for databases which significantly increase the power of search or manipulation capabilities; and new object representations or data structures.

(f) **Software engineering** involves the study, in terms of basic or applied research, of the methodology for the design, implementation, testing, and performance evaluation of software systems; that is, advances in the methodology required to construct computer programs with greater flexibility, efficiency, reliability, and ease of maintenance.

(g) **Artificial intelligence (AI)** involves the study of systems that perform functions parallel to those usually carried out by humans. Scientific and technological advances are made in areas such as machine vision, robotics, inference, knowledge representation, expert systems, theorem proving, natural language understanding, automatic language translation, logic programming, and future generation systems. In most areas of AI, there is not yet an established practice. However, the attempt to resolve a technological

uncertainty has to be demonstrated to provide a basis for establishing whether expenditures are eligible. Frequently in this area the existence of any kind of solution is uncertain, and the research effort will reflect this indeterminacy.

7 Considerations in Determining When an Experimental Development Project is Complete

7.1 The development of a new or improved product or process through a program of experimental development can be shown to occur in five stages:

(a) The definition of a concept or technological hypothesis together with a statement of corresponding technological objectives.

(b) The definition of a systematic program to achieve the technological objectives defined in (a). As far as possible, this will describe a technological development plan and program including various subprojects, milestones, and steps along the development path.

We expect that such a plan likely will have to be changed as the development progresses because of the uncertainties that characterize technological developments.

(c) The process or product is developed to the prototype or pilot stage for experimental or technical-trial purposes. That is, prototypes are to test the feasibility of the concept or hypothesis. Possibly, the construction of a whole series of pilots or prototypes may be involved, as problems are met and either overcome or bypassed. It may be that, in this phase of the development, the original objectives have to be modified significantly or perhaps even changed entirely, depending on the technological opportunities which become apparent. However, such cases should be regarded for purposes of subsection 2900(1) of the Regulations as a series of scientific research and experimental development projects with distinct and documented technological objectives.

(d) The product or process is developed to meet the requirements of commercial production. This stage may involve activities such as scaling up from pilot plant size to commercial size, or developing an economical means for manufacture. In many cases, the technologically successful prototype may have been fabricated using methods or materials which are too expensive to be practical for commercial production.

(e) Commercial utilization or production.

While the five stages are not always described by companies in the format given above, they are, nevertheless, involved in some manner in most technological developments. Variations do exist and are to be expected. For example, the third stage (c) is sometimes bypassed, and the “prototype” is developed to meet commercial requirements. In some cases, the development may consist of systematically constructing a series of prototypes, each incorporating the lessons learned from earlier prototypes.

7.2 When an experimental development project is involved, the work carried out in the first three stages is eligible. Difficulty may arise in determining whether some activities falling within the bounds of the fourth stage (d) are eligible. In this respect, the key issue is whether there is a technological uncertainty still to be overcome, or whether this stage can be carried out through standard practice (see Part 4). Activities associated with commercial production (the fifth stage) are not eligible as scientific research and experimental development activities.

7.3 The application of criteria that will determine whether an experimental development activity should be classified as complete will differ from case to case. It is useful to recognize the following general situations:

Situation 1: The development, design, and manufacture of multiple products in regulated and unregulated industries.

Situation 2: The design and construction of a specialized (customized) product (i.e., “one of a kind”), or of specialized products produced in small numbers in regulated and unregulated industries.

Situation 3: The development or upgrading of processes for sale and/or use by the developer.

However, the basic criterion for determining when a scientific research and experimental development project has been completed is reaching the point at which the project's initial technological objectives have been achieved. Generally, this occurs when the application of standard operating practices will permit the achievement of the technological performance objectives which were established when the project was defined.

Neither financial indicators (such as first sale) nor issuing warranties alone, for example, are adequate to mark where experimental development separates from commercial production.

7.4 “Regulated” means that the product or process has to meet some generally accepted, well-defined technological acceptance test or tests, or technological specifications, before it can be registered, marketed, or certified. These requirements may be established by either formal regulatory agencies, by the industries, or by other bodies offering certification.

7.5 In regulated industries where specifications for product performance, registration, certification, and/or safety are enforced or are generally accepted, studies required to meet these requirements or standards are eligible activities.

If, however, a product is sold initially in an unregulated or less stringently regulated market, the experimental development project is considered to be complete when the technological objectives required for the initial project are met. As markets are expanded, studies to demonstrate that

more stringent regulation or standards for registration or certification can be met are eligible as separate experimental development studies (see Note 1). These studies are complete when the data demonstrates whether or not the new regulations or standards have been met. Additional activities, such as the preparation of submissions or documents for licensing agencies, certification agencies, or regulatory authorities, are not eligible activities.

Note 1: Studies carried out to demonstrate that regulatory requirements or standards can be met are considered eligible activities because we assume that a technological or scientific uncertainty must be resolved to complete the product to the satisfaction of the regulatory authorities. These studies are complete when the data demonstrate that the technological uncertainty is resolved.

7.6 Market demonstrations, including customer acceptance studies, product verification, and marketing studies comparing a new product or process with those of competitors are part of the marketing process, and are not eligible activities regarding experimental development.

In both regulated and non-regulated industries, technological specifications are determined by commercial objectives and by end-user requirements. It is necessary to define these requirements and to devise corresponding internal technological specifications. It is appropriate that work on defining such technological specifications be eligible, so long as these specifications have contributed directly to the characterization of the technological objectives of a scientific research and experimental development project that is under way.

As noted previously, however, market research itself is an excluded activity under subsection 2900(1) of the Regulations.

7.7 Experimental development of a customized process or product is usually complete once the product or process meets the intended technological objectives. Putting the customized product to its intended use indicates that the experimental development has been completed at some earlier time.

When a customized process is ready to be developed on a commercial scale, experimental development is generally complete. However, technological problems may arise during the attempt to use the new technology, and the activities required to correct these may be classified as new, eligible scientific research and experimental development projects.

7.8 In general, the routine “scaling up” from prototype or pilot demonstrations is not eligible. However, specific scientific research and experimental development projects may be identified during this phase which will become eligible (see Part 4).

7.9 “Pilot plants” may sometimes be built to a commercial scale, or existing commercial plants may be modified so as to test and demonstrate new processes. In such instances, much technological advancement may be required, and eligible scientific research and experimental development may be involved in developing what will eventually be a commercial facility.

The qualifying expenditures for scientific research and experimental development within such projects must be separated from those which would usually be associated with constructing a commercial plant if the technology had already existed. The cost of the scientific research and experimental development activities should be isolated by accounting individually for their costs.

7.10 The usual manufacturing facilities may sometimes be employed in scientific research and experimental development activities to confirm the success of eligible process and/or product development projects. Appropriate costs incurred from using the facilities can be allowed if they meet the requirements of section 37 and if the use is documented as part of a preplanned, systematic development program. It is necessary to establish the specific periods of use.

7.11 Experimental development work for the purposes of creating new, or improving existing, materials, devices, products, or processes, including slight improvements, is complete when the technological objectives are met.

8 Administrative Comments

8.1 Departmental specialists or advisors

In addition to obtaining the advice of specialists in other federal departments and agencies, as authorized by subsection 37(3) of the Act, we may engage outside specialists to determine whether or not certain activities being carried on by a taxpayer qualify as scientific research and experimental development. Following a review of information contained in the taxpayer's submission by technical staff, we will decide if we need more information.

During an on-site examination, the specialist, accompanied by one of our auditors, will meet with the taxpayer's research personnel, and will review the activities for which questions still exist, to obtain sufficient information to make an informed opinion as to whether each activity qualifies as scientific research and experimental development.

8.2 Confidentiality

8.2.1 Commercial secrecy

Recognizing that scientific research and experimental development plans and activities have a vital bearing on a company's competitive position, and that the information is proprietary, we are required by law to treat any information that a taxpayer gives us in the strictest confidence. Such information may not be revealed to any person who does not have a need for it to perform the duties connected with administering the program. All documents that contain proprietary information submitted in connection with the program should be marked “Commercial confidential.”

When we use the services of a specialist to evaluate claims for scientific research and experimental development, the

specialist falls within the provisions of section 241 of the *Income Tax Act*. The Act provides for fines and/or imprisonment if the provisions of section 241 are breached.

8.3 Advance rulings

Our issuing advance rulings regarding scientific research and experimental development has been limited to the financing aspects of such transactions.

8.4 Form T661

The T661 is a prescribed form that we require for filing claims for scientific research and experimental development under section 37 of the Act and subsection 2900(1) of the Regulations.

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Scientific Research and Experimental Development

Glossary

Associated established components

If the scientific research and experimental development is directly concerned only with some parts of a system or a technology, and resolving the technological uncertainty cannot be done without subsequently modifying other parts, then these other parts are considered associated established components.

Baseline data

Baseline data are a set of scientific or technological observations and measurements that are used as a base in further studies, and against which variations or change can be measured. Examples are pollution in a given environment, nature and rate of rejects on a production line, hydrological data to develop a dynamic model of hydropower capacity, etc.

Business environment

Business environment characteristics include business size, competition, area of industry, and access to technical resources. For example, an enterprise may not have practical access to information proprietary to a competitor, or known in specialist or academic circles.

Commercial production

Commercial production is the set of activities associated with the production of products, and it is expected that a profit will be made.

Commonly available sources of knowledge or experience

Commonly available sources of knowledge or experience are those that can reasonably be assumed to be readily available to those with basic training or experience in the field of concern. These resources enable them to be sufficiently qualified to participate in scientific research and experimental development. They also include knowledge that is available in the business context of the firm. See also the Glossary entry on “Business environment.”

Cost targets and their relation to technological uncertainty

See Part 2.10.2 of the circular.

Customary product design or customary product evolution

Customary product design or customary product evolution is the use of generally known practices to design or improve a product or process when there is no need to resolve scientific or technological uncertainty.

Design

Design may be separated into engineering design and industrial design.

Engineering design is assembling established technological information on any subject, selecting whatever is pertinent, and from it, working out a practical, economical, and safe design. If the result does not meet expectations, the cause of failure would be either the incorrect application of engineering principles, or errors of information, neither of which would constitute a deficiency in essential scientific or technological knowledge.

Industrial design is the conception of potentially marketable products with due regard to their desired functions, properties of materials, harmonious integration of components, possibilities offered by various fabrication processes, required dimensions and shapes and, in general, aesthetic and economic considerations. Thus, industrial design often seeks to become functional at minimum cost.

Engineering and industrial design activities are eligible activities only when they are undertaken directly in support of projects that themselves satisfy the three criteria specified in Parts 2.9. to 2.10.3 inclusive.

Directly in support

An activity is considered to be directly in support of scientific research and experimental development when it is reasonable to believe that the activity is required to carry out the scientific research and experimental development. That is, it has been shown to be an integral part of the systematic investigation of a problem, and is required in the search for a theoretical or practical solution.

Hypothesis

A hypothesis is a tentative supposition with regard to an unknown state of affairs, the truth of which is thereupon subject to investigation by any available method, either by logical deduction of consequences which may be checked against what is known, or by direct experimental investigation or discovery of facts not hitherto known and suggested by the hypothesis (McGraw-Hill, *Concise Encyclopedia of Science and Technology*).

Intuitive processes

Intuitive processes are those that give rise to ideas without evident, ordered, rational thought or inference. Such activities can lead to hypotheses for testing that are a component of experimental development.

Market demonstration/customer acceptance

In a scientific research or experimental development project, market demonstration or customer acceptance does not include interaction with the customer to better define the product's technological specifications and thus to better

orient the project's scientific research and experimental development activities.

Market research

Market research includes (but not exclusively) surveys to determine consumer attitudes to existing products, or to possible new products.

The research, for example, examines such factors as buying habits, use of leisure time, consumer needs or wants, and attitudes towards existing products and new products being test-marketed. Sales promotion is the selling activity that supplements advertising and personal selling, co-ordinating them, and making them effective.

Meaningful advance

A meaningful advance means the generation of new knowledge that reduces technological uncertainty. Note that this can be negative (i.e., the sought result could not be achieved) or positive, in which case the advance is embodied in the resulting process or products or in new knowledge. See also the Glossary entry on "Systematic investigation or search."

Operations research

Operations research is an approach usually involving mathematical treatment of a process, problem, or operation to determine its purpose and effectiveness, and to gain maximum efficiency.

Pilot plant

A pilot plant is a non-commercial scale plant in which processing steps are systematically investigated under conditions simulating a full production unit. The goals may be, for example, to study the behaviour of certain raw materials, develop an economically viable process for manufacturing a new product or process or improve an existing product or process, modify equipment for new applications, test new equipment under new conditions, produce samples of a custom product for scientific research, determine environmental effects, and so on. The primary purpose of the pilot plant is to obtain engineering and other data needed to evaluate hypotheses, write product or process formulae, establish finished product technical specifications, or design special equipment and structures required by a new or improved fabrication process.

The construction and operation of a pilot plant is a part of experimental development, as long as the principal purposes are to obtain experience, and to compile engineering and other data to be used in:

- evaluating hypotheses;
- writing new product formulae;
- establishing new finished-product specifications;
- designing special equipment and structures required by a new process; or
- preparing operating instructions or manuals on the process.

Planned approach

Planned approach refers to a situation in which there is a recorded program of work with scientific and technical content. See also the Glossary entry on "Hypothesis."

Process optimization and cost reduction

Process optimization and cost reduction describe process development efforts that have as their objective improved efficiencies, output quality, or financial or strategic advantages. Although these activities can still be eligible when technological uncertainty is encountered, they are not usually considered to be scientific research and experimental development. Competent management of a commercial operation usually reflects the skills and knowledge necessary for greater efficiency, and lowers the unit costs of production. They are represented, for example, by the functions of industrial engineering, time and motion analysis, methods engineering, value analysis and engineering, tool and machine design, etc. When standard practices in these fields are used in any situation requiring an improvement, a trend towards optimal conditions will usually result, and the law of diminishing returns will be the only limitation upon attaining the degree of improvement. Only if a technological uncertainty must be overcome will an eligible activity exist, and the qualifying costs will be those needed to resolve the technological problem.

Prototype

A prototype is an original model on which something new is patterned, and of which all things of the same type are representations or copies. It is a basic experimental model possessing the essential characteristics of the intended product. The design, construction, and testing of prototypes generally fall within the scope of experimental development. This applies whether only one or several prototypes are made, and whether they are made at the same time, or one following the other. Constructing several copies of a prototype to meet a temporary need after successfully testing the original is not part of experimental development.

Routine engineering

"Routine engineering" is the practice of designing, composing, evaluating, advising, reporting, directing, or supervising the construction or manufacturing of tangible products, assemblies, systems, or processes that require in-depth knowledge of engineering science, and the proper, safe, and economic application of engineering principles. By definition, and according to sound professional practice, routine engineering practice does not involve appreciable scientific or technological uncertainty.

Social sciences

The social sciences include (but not exclusively) economics, geography, law, management, political science, and sociology. The humanities include, for example, art, philosophy, languages, history, and religion. Psychology is also a social science, but psychological research is not an excluded activity when it is undertaken directly in support of basic research, applied research, or experimental development.

Specialists

A specialist in a field is one who has gained, through training or experience, a significant understanding beyond that usually expected from general or only occasional activity within that field. The term “specialists” refers to engineers or scientists holding a university degree, or the equivalent, as recognized by the appropriate licensing body or professional or scientific society, or to individuals who have worked in the given field of technology or a closely related one for a significant period to be considered by their peers to have gained experience beyond the norm.

Style change

Style change means changing the physical appearance or arrangement of an article without altering its utility, efficiency, function, or operating characteristics.

System uncertainty

System uncertainty is recognizing that combinations of technologies, the components of which are generally well-known, frequently carry a risk of failing to perform to acceptable standards. Thus, while each individual technology is known, the results of interactions among them as a whole may not be known, and must be determined by a program of systematic investigation to determine the results of such interactions.

Systematic investigation or search

Systematic investigation or search is the use of a method that usually includes scientific or technological problem definition, hypothesis formulation, experimental tests, and deduction and conclusion to arrive at new or improved products or processes, or expanded knowledge. It includes analyses through physical, chemical, or biological experimentations, mathematical or computer simulations, or other analytical techniques.

Testing protocols

Testing protocols are the standardized methodologies or procedures used in scientific and technological endeavours.

Trouble-shooting

Trouble-shooting is routinely correcting equipment or processes by identifying problems. The goals may be to optimize a process in both the technical or economic sense, to adjust equipment performance or to evaluate it during breakdowns, improve working conditions, minimize production losses, or to control the generation and disposal of wastes.

Trouble-shooting occasionally brings out the need for further scientific research and experimental development, but more frequently it involves detecting faults in equipment or processes, and results in minor modifications of standard equipment and processes. Such detection and modification is not scientific research and experimental development.

Viable program

A viable program is one that is based on approaches and methods that are inherently capable of resolving the technological uncertainty in question (resulting in either success or failure, as the case may be).