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Historical Article—

History of Regulatory Requirements for Poultry Biologics in the United States, 1970s to 1990s

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SUMMARY. By the end of the 1960s, The United States Department of Agriculture (USDA) had established the basic purity and safety standards for poultry biologics in the United States and had licensed products to address many of the major poultry diseases of concern at that time. The emergence of new diseases, advances in scientific technology, and changes in poultry husbandry practices that occurred in the 1970s to the 1990s required the development of many new and amended regulatory requirements to keep abreast of the changing needs of the poultry industry. Veterinary Services often approved the use of special or conditional licensing procedures to shorten the time to license products needed to address emerging diseases. Infectious bronchitis, bursal disease, fowl cholera, duck virus enteritis, avian influenza, and other vaccines were rapidly licensed to address emerging disease problems using this procedure. Changes in labeling and packaging requirements were made to address changing vaccination practices. Veterinary Services permitted diluents to be shipped separate from product, first for Marek's disease vaccine and later for vaccines recommended for administration by automatic vaccinating machines. The maximum number of doses permitted to be in one container and package were also amended to address the increased size of poultry flocks. Veterinary Services also approved the use of split manufacturing procedures that permitted two or more licensed manufacturers to work together in the production of a product. This innovative use of licensing products for further manufacture allowed the industry to use production facilities more efficiently and provided a wider variety of combination products. In 1985, Congress passed an amendment to the Virus-Serum-Toxin Act that gave USDA the authority to regulate all veterinary biological products shipped in or from the United States. This amendment brought intrastate biologics manufacturers under federal jurisdiction and ensured all biological products shipped in or from the United States met the same standards of purity, safety, potency, and efficacy. The development of new recombinant DNA (r-DNA) techniques for the production of vaccines required USDA to establish new procedures and rules for the review of these products prior to their release into the environment and eventual licensure. Compliance with the National Environmental Policy Act required the preparation of environmental risk assessments and public participation in the field testing and licensing of live r-DNA products. This article addresses some of the history of these and other changes in regulatory requirements for poultry products that took place in the 1970s to the 1990s, but space does not permit us to address all of the changes that have occurred. We have presented some of what we consider the most notable events in this process and leave it up to future historians to address events that may not have been included.

RESUMEN. *Reseña Histórica*—Historia de los requerimientos regulatorios para los productos biológicos para la avicultura en los Estados Unidos de 1970 a 1990.

A finales de la década de los años 1960s, el Departamento de Agricultura de los Estados Unidos (con las siglas en inglés USDA) había establecido los estándares básicos de pureza y de inocuidad para los productos biológicos usados en la avicultura de los Estados Unidos y había emitido licencias de productos para enfrentar muchas de las enfermedades de las aves importantes en ese tiempo. La aparición de nuevas enfermedades, los avances en la tecnología científica y los cambios en las prácticas avícolas que se produjeron entre los años 1970 y 1990 requirieron el desarrollo de nuevos requerimientos regulatorios o la modificación de los existentes para estar de acuerdo con las necesidades cambiantes de la industria avícola. La oficina de Servicios Veterinarios a menudo aprobó el uso de procedimientos especiales o emitió licencias condicionales para acortar el tiempo de emisión de licencias de los productos necesarios para hacer frente a las enfermedades emergentes. Las vacunas contra la bronquitis infecciosa, la enfermedad infecciosa de la bolsa, cólera aviar, enteritis viral del pato, la influenza aviar y otras vacunas, fueron autorizadas rápidamente para enfrentar a estas nuevas enfermedades mediante este procedimiento. Los cambios en el etiquetado y envasado se hicieron debido a cambios en las prácticas de vacunación. La oficina de Servicios Veterinarios permitió que los diluyentes fueran enviados por separado del producto, primeramente para la vacuna contra la enfermedad de Marek y más adelante para las vacunas recomendadas para su administración mediante máquinas automáticas de vacunación. El número máximo de dosis permitidas en un envase y embalaje también se modificaron para hacer frente al aumento de tamaño de las parvadas avícolas. La oficina de Servicios Veterinarios también aprobó el uso de procedimientos de fabricación que permitieron a dos o más fabricantes con licencia trabajar juntos en la producción de un producto. Esta manera innovadora de establecer licencias para manufacturas posteriores permitió a la industria el uso más eficiente de las instalaciones de producción y proporcionó una variedad más amplia de combinaciones de productos. En 1985, el Congreso aprobó una enmienda a la Ley referente a los Virus, Sueros y Toxinas (Virus-Serum-Toxin Act) que le dio autoridad al Departamento de Agricultura para regular todos los productos veterinarios biológicos enviados dentro y fuera de los Estados Unidos. Esta enmienda introdujo a los fabricantes de productos biológicos intraestatales dentro de la jurisdicción federal y aseguró que todos los productos biológicos enviados para consumo dentro y fuera de los Estados Unidos reunieran los mismos estándares de pureza, inocuidad, potencia y eficacia. El desarrollo de nuevas técnicas de ADN recombinante (r-DNA) para la producción de

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vacunas, requirió que el Departamento de Agricultura estableciera nuevos procedimientos y normas para la revisión de estos productos antes de su aplicación y emisión en el medio ambiente y para emitir sus licencias definitivas. El cumplimiento de la Ley Nacional de Política Ambiental requiere la preparación de evaluaciones de riesgo ambiental y la participación pública en las pruebas de campo y los métodos de emisión de licencias para vacunas vivas de ADN recombinante. En este artículo se aborda parte de la historia de estos y otros cambios en los requisitos regulatorios para los productos avícolas que tuvieron lugar entre los años 1970 y 1990, pero el espacio no permite hacer frente a todos los cambios que se han producido. Se presentan algunos de los acontecimientos más notables de este proceso y se deja en las manos de futuros historiadores para hacer frente a acontecimientos que no han sido incluidos.

Key words: poultry biologics, regulatory requirements, history, changing requirements, changing needs

Abbreviations: 9 CFR = Title 9 Code of Federal Regulations; AHI = Animal Health Institute; APHIS = Animal and Plant Health Inspection Service; EA = environmental assessment; FDA = U.S. Food and Drug Administration; FONSI = finding of no significant impact; IBDV = infectious bursal disease virus; OMB = Office of Management and Budget; r-DNA = recombinant DNA; USDA = United States Department of Agriculture; VBLC = Veterinary Biologics Licensees Committee; VS = Veterinary Services; VST Act = Virus-Serum-Toxin Act

The early history of the development of regulatory requirements for poultry biologics in the United States has been described (1). This article addresses the further development of regulatory requirements for such products that have been issued to keep abreast of new scientific and technical developments as well as changes in husbandry and disease management practices within the poultry industry.

By the end of the 1960s, the United States Department of Agriculture (USDA) had established the basic purity and safety standards for poultry biologics, and the list of licensed biological products had expanded to address many of the major diseases of poultry. However, with suppression of the diseases that plagued the early poultry industry, new diseases caused by new pathogens or different strains or types of known pathogens began to emerge. As these diseases were diagnosed and their causative agents identified, biologics manufacturers developed new products to control them. Scientific advancements in the production and testing of biological products and the licensing of these new products required the USDA to develop new and amended regulatory requirements to keep abreast. Integration of the poultry industry, larger flocks, new methods of mass administration, and changes in the production and marketing of products required adjustment of regulatory requirements to meet the changing needs of the industry. This paper addresses the history of some of the changes that occurred in the production and regulation of poultry biologics beginning in the 1970s.

PRODUCTS FOR EMERGING DISEASES

The National Animal Disease Laboratory, research and diagnostic laboratories at state universities, and Agriculture Research Service regional poultry research laboratories have traditionally worked closely with the poultry industry in the United States to identify emerging diseases. They have also worked closely with the veterinary biologics industry and federal biologics regulatory authorities in the rapid development and licensing of biological products needed to protect the poultry industry from these new disease conditions. When new pathogens are isolated and promising biological products developed to control them, biologics regulatory authorities need to give priority in their review and licensing of these products. Veterinary Services (VS) has often used conditional licensing procedures provided in Title 9 Code of Federal Regulations (9 CFR) Section 102.6 (this was called special licensing prior to 1985 and the passage of the amendments to the Virus-Serum-Toxin Act [VST] Act) to accelerate the licensing process in such cases. VS has also provided assistance in the importation of promising new seed virus strains from other countries when it appears they could be used to produce an effective vaccine for disease problems in the United States.

The emergence of Marek's disease in the broiler industry, which was described by Espeseth and Lasher (1) and triggered the issuance of special licenses for Marek's disease vaccine, live turkey herpes virus, tissue culture origin on March 1, 1971, is one example of the use of special licenses to accelerate the availability of a needed vaccine (1). In 1983, when it became evident that the turkey herpes virus vaccines were not adequate to control new emerging variant strains of Marek's disease, the Animal and Plant Health Inspection Service (APHIS) issued a special license for Marek's Disease Vaccine, SB-1 strain, Tissue Culture Origin, to address the problem. Other examples of APHIS' use of special or conditional licenses include the following instances.

When the University of Delaware isolated the JMK type infectious bronchitis virus from a respiratory disease outbreak in the Delmarva Peninsula and a suitable vaccine strain of the virus was developed, Sterwin Laboratories applied for and was issued a special license in 1974 for bronchitis vaccine, live virus, JMK type, to control the problem. Special licensing was also used to make Arkansas- and Georgia-type bronchitis vaccines rapidly available when these types were identified.

APHIS imported seed viruses for Holland strains of infectious bronchitis virus, H-52 and H-120, in 1973, from Philips-Duphar. Dr. R. W. Winterfield had demonstrated in 1972 that these strains provided a broader spectrum of protection against domestic strains of the virus (6). Sterwin Laboratories was selected by APHIS to prepare master seed viruses that were deposited at the VS Biologics Laboratory for distribution to all interested biologics licensees. APHIS also used special licenses to make these vaccines available.

To address losses due to fowl cholera in turkeys, a special license was issued in March 1976, for *Pasteurella multocida* vaccine, live avian isolate, oral, to Amerlab, Inc.

Infectious bursal disease virus (IBDV), also known as Gumboro, was isolated from broiler flocks located in Gumboro, Delaware, in 1957 by Albert Cosgrove at Delaware Poultry Laboratories. Further studies revealed that the target organ of IBDV was the bursa of Fabricius, which has an essential role in the early immunogenesis of young birds. IBDV infections were found to cause limited to extensive damage to the bursa of chicks, thus reducing their ability to respond to vaccinations and also making them more susceptible to other diseases. Using a slightly attenuated strain of IBDV isolated by I. M. Moulthrop, of the University of Maryland, Sterwin Laboratories prepared and obtained a special license for the first bursal disease vaccine, live virus, on January 22, 1969. This product

was recommended for use in birds 7–14 days of age being reared on contaminated premises. When it was found that progeny from susceptible flocks were more susceptible to anemia and dermatitis, the use of this product was expanded to include vaccination of negative breeder flocks to seroconvert them to a positive state. Several product licenses were issued for a cloned intermediate bursal disease vaccine that was developed by Dr. Caswell Eidson, University of Georgia, by modifying the original Moulthrop strain. W. Baxendale, in the United Kingdom, reported on the development of an apathogenic IBDV in 1976 that caused no gross or histological lesions in the bursa of susceptible birds and had no significant immunosuppressive effect. In an agreement with Intervet B. V., Sterwin Laboratories imported the Baxendale strain and obtained a special license for bursal disease vaccine, modified live virus, chicken embryo origin, on February 2, 1977. This vaccine was recommended for use in susceptible birds to be placed on premises with a history of infectious bursal disease (4,5).

A special license was issued to Long Island Duck Research Cooperative, Inc. for duck virus enteritis vaccine, live virus, chicken embryo origin, on October 19, 1977.

Experimental avian influenza vaccine, KV, was made available to the poultry industry in the early 1980s under the provisions of 9 CFR Section 103.3 (field trial authorization) with exemption from the ''Not for Sale'' provisions. In 1985, APHIS issued conditional licenses for serotypes other than H5 and H7. To avoid interfering with USDA efforts to eradicate highly virulent avian influenza H5 and H7 serotypes, further distribution of these two serotypes under the provisions of 103.3 was permitted by APHIS only with the specific approval of the Deputy Administrator of VS.

Autogenous biologics are often used when licensed products are not available or not efficacious to immunize against a disease condition in a herd or flock. With the integration of livestock and poultry operations, more herds and flocks became epidemiologically linked, and requirements that autogenous products only be used in the herd or flock from which the organisms were isolated was no longer appropriate for many livestock and poultry operations. VS responded to this need by issuing a VS Notice in March of 1983, that outlined procedures for obtaining authorization to prepare autogenous biologics to be used in adjacent and nonadjacent herds or flocks other than those from which the organisms were isolated when these herds or flocks could be demonstrated to be epidemiologically linked.

UPDATING OF MIXED BACTERINS

VS issued a notice to the industry on November 6, 1974, entitled, ''Reevaluation of Biological Products'' that resulted in the formation of a cooperative task force between APHIS and biologics licensees called the Veterinary Biologics Licensees Committee (VBLC)-APHIS Ad Hoc Subcommittee on Mixed Bacterins. This committee was established to review and update several old formulations of mixed bacterins including some specific bacterial products that lacked validated efficacy data and did not have potency tests for release. The use of the name ''Mixed Bacterin'' was deleted, and product nomenclature was established that required specific identification of each product microorganism by genus and species. Those microorganisms that were no longer considered efficacious were removed from products. Potency tests for serial release, correlated with host animal efficacy, were developed for the remaining combination products (Price, R. J., Encouraging New or Improved Biologicals, Western Poultry Disease Conference, March 1977).

MARKETING CHANGES

The poultry biologics industry is highly competitive, and licensees are thus motivated to meet the needs of their customers. However, many regulations promulgated prior to the 1970s prohibited them from responding to their customer's requests. Many rules and regulations that were appropriate when the industry was in its infancy had become obsolete under modern production and marketing procedures. Licensees working through the VBLC often petitioned APHIS to amend the regulations and policy memorandums to allow changes to meet their customer's requests. In some cases, the poultry industry petitioned APHIS directly to request such changes.

When first licensed, Marek's disease vaccines were marketed as frozen product in liquid nitrogen containers. This method of packaging did not permit the packaging of product and necessary diluent in the same carton as had been required of all products in the past. In June 1972, VS responded to Marek's disease licensee's requests, and issued a VS Notice approving the use of packages containing from 1 to 10 multiple dose vials of MD vaccine (frozen) containing 500 to 1000 doses per vial. This notice also approved the packaging and shipping of diluent separate from vaccine, provided diluent was shipped to customers at the same time as the vaccine. In October 1972, an additional VS Notice was issued that amended this policy to permit export of MD vaccine without diluent, provided an acceptable plan for providing the proper amount of diluent at destination was filed with VS. In view of data indicating MD vaccine may be more stable when restored with room temperature diluent than when restored with refrigerated diluent, VS also permitted firms to recommend the restoring of frozen vials of their vaccine with room temperature diluent if data demonstrated this to be satisfactory for their vaccine.

VS further amended its policy concerning the packaging of diluent in the same carton as the product, by issuing a notice in February 1979 granting an exemption to 9 CFR Section 112.6 to permit diluent for products intended for administration by automatic vaccination equipment (Beak-O-Vac machines) to be packaged separately from the vaccine for shipment provided the proper diluent in the proper amount was provided to the user.

In 1980, representatives from the poultry industry contacted APHIS requesting that VS amend 9 CFR Section 112.6(d) to permit biological products recommended for use in poultry to be packaged in multiple-dose final containers larger than 1000 doses. On October 17, 1980, VS issued a VS Biologics Notice to poultry vaccine manufacturers informing them that USDA was considering revising its regulations to permit the packaging of poultry vaccines in final containers larger than 1000 doses and asked for their comments. The Animal Health Institute (AHI), VBLC, Poultry Products Committee discussed this issue at their November 1980 meeting. Individual firms were requested to submit their comments to the Veterinary Biologics Staff and the committee agreed to request a meeting to discuss this issue with the APHIS Deputy Administrator (Minutes of VBLC Poultry Products Committee, November 20, 1980). APHIS continued to move forward and issued a VS Notice dated February 2, 1981, stating that favorable consideration would be given to license applications or outline revisions for poultry vaccines designated for mass administration, in multiple dose final containers larger than 1000 doses, and that an increase in the size of containers for fowl pox and fowl larnygotracheitis vaccines administered to individual birds from a maximum of 500 to 1000 doses would also be favorably considered. The AHI wrote to Harry C. Mussman, Administrator of APHIS, urging APHIS to withdraw this notice and to amend Section 112.6

only after compliance with the requirements of the Administrative Procedures Act. APHIS responded that USDA did not intend to override Section 112.6 but intended to initiate rule-making to amend that section. As promised, a proposed rule to change 9 CFR, 112.6 to permit vials of poultry vaccines containing more than 1000 doses, was published for comment on September 14, 1981. James L. McVey, Chairman, AHI, VBLC Poultry Products Committee submitted comments on the proposed rule on November 13, 1981, opposing the proposed revisions indicating such change ''threatens the integrity of those products; and second, the proposed revision would result in increased cost to consumers.'' He also commented that if section 112.6 was revised to eliminate the 1000-dose limit, it should also be amended to eliminate the requirements that no more than 10 poultry product final containers be packaged in a single carton, and that diluent for desiccated poultry products be packaged with the final container(s) of the product, since these added changes would not have a deleterious effect on the quality of these products and would permit more economical and efficient production and marketing (J. L. McVey, letter from VBLC Poultry Committee to Dr. J. K. Atwell, November 13, 1981). The committee followed these comments with a meeting to discuss the issue with Pierre Chaloux who had recently become the APHIS Deputy Administrator, replacing J. K. Atwell. In their meeting with P. Chaloux, the committee indicated that because of technical and economic problems in the production of larger dose vials it was their position that the proposed change in the regulations would not be in the best interest of the poultry industry (Minutes of committee's meeting with P. Chaloux, January 8, 1981). In spite of these objections, a final rule eliminating the limit of 1000 doses per vial of poultry vaccines recommended for mass administration was published on March 2, 1982. Additional amendments addressing VBLC's suggestions to remove restrictions on the number of containers in a package and the requirement that products be packaged with their diluent in the same carton were published March 28, 1983.

The poultry industry often diluted Marek's disease vaccines beyond that recommended on the label when used in broilers. This practice required the use of significant amounts of diluent beyond that provided by licensees to restore the product in accordance with the label recommendations. The demand for additional diluent for this purpose soon resulted in the emergence of diluent manufacturers that were not subject to the provisions of the VST Act, since diluent is not a veterinary biological product as defined in 9 CFR. Concern that some diluents may not be compatible with licensed products or meet acceptable standards of purity, led the Center for Veterinary Biologics to issue a VS Notice on May 17, 1983, providing guidelines to the industry on the production and distribution of sterile diluent in USDA licensed facilities and in unlicensed facilities. This notice was made a continuing policy and issued as VS Memorandum no. 800.74 on May 21, 1985.

SPLIT MANUFACTURING

From the early days of the biologics program, it had been a policy that unless authorized by the administrator, in the case of equipment failure or other emergency, a product must be produced entirely within each manufacturer's licensed facilities. However, as means of transportation improved, the industry requested that this policy be amended to permit the exchange of partially completed products and/or product fractions between licensed facilities to permit one or more licensed manufactures to work together in the production of a product. Initially USDA resisted this concept because under the VST Act, only licensed products could be shipped from one state to another. With some creative thinking, the biologics program proposed the concept of licensing products for further manufacture that would make such shipments legal under the VST Act. APHIS issued an amendment to regulations in 9 CFR 114.3 authorizing this approach on November 21, 1984. These enabling regulations were followed by the issuance of VS Memorandum No. 800.61, ''Split Manufacturing of Veterinary Biological Products,'' on December 4, 1984, to provide guidance on the policies and procedures for implementing this practice.

AMENDMENTS TO THE VIRUS SERUM TOXIN ACT

Dr. John Hejl, working with the USDA Office of General Consul in 1967, initiated a project to completely revise the VST Act (Proceedings of VBLC, November 15, 1967). A draft copy was reviewed by the AHI, VBLC and several changes were suggested. Further revisions were made, but the Office of Management and Budget (OMB) was reluctant to approve the document as presented. Further revisions were drafted, but the biologics industry was not supportive and the project was given a low priority. In 1981, the new Animal Biological Products Act bill was finally introduced to Congress. However, it was met with strong opposition from the livestock industry and unlicensed intrastate biologics manufacturers and was soundly defeated.

In 1982, efforts were made to renew interest in the passage of new legislation that would address the growing problem of intrastate biologics manufacturers. A USDA survey in 1984 revealed that only 15 states required that veterinary biological products used within their boundaries be licensed by USDA, and only two states actively regulated the intrastate production and sale of veterinary biologics. APHIS was concerned about the safety and efficacy of intrastate products produced in the remaining 48 states where they were almost free of any official control. Products purportedly prepared for shipment only in intrastate commerce were often found in interstate commerce. It was determined the Food, Drug, and Cosmetics Act provided authority for the U.S. Food and Drug Administration (FDA) to regulate intrastate biological products; however, the FDA had not developed a regulatory program for such purpose (2). A new draft of the Animal Biological Products Act was developed that took into account the objections raised to the previous bill. Interested parties were invited to Washington D.C. to review the new draft. From the comments received at this meeting, further adjustments and changes were made. Provisions for conditional licensing to facilitate rapid licensing of products to meet emergency conditions, limited market or local situation, or other special circumstances based on purity, safety, and a reasonable expectation of efficacy were included in the draft as well as exemption from licensure for products produced by a person for use in that person's own animals, and for products produced by veterinarians for use under a veterinarian–client–patient relationship in a state licensed veterinary practice. Over the next several months, the amended draft was presented and discussed at several livestock, state, and industry meetings. As a result of this effort, support for the new draft began to grow. However, the state of California, which had several intrastate biologics manufacturers and a state biologics control program, had objections to a federal takeover of this function. As a result of further negotiations with the California Department of Agriculture and Patton Smith, California State Veterinarian, provisions were made in the draft bill to exempt state licensed biologics establishments from federal licensure in states that had control programs that were reviewed by VS and found to meet certain criteria. This provision

allowed the intrastate distribution of state licensed biologics only within such states.

With these changes, passage of a new Animal Biological Products Act gained strong support from most groups. Delays occurred, however, when OMB found that the FDA objected to the proposed bill. To bypass these objections, the AHI pursued passage of an amendment to the existing VST Act that incorporated the key elements and changes that had been included in USDA's proposal. This proved to be an acceptable approach to Congress and on December 23, 1985, an amendment to the VST Act was passed that expanded USDA authority to ensure uniform standards for all veterinary biological products shipped in or from the United States (2).

Intrastate manufacturers were permitted to apply for exemption from federal licensure for a period of 4 years to phase out their operations or obtain federal establishment and product licenses. Fifty-seven intrastate establishments applied for this exemption for 2199 products. By October 1989, 15 of these companies had obtained establishment licenses and a total of 76 product licenses (2). California was the only state that requested and was approved to retain its state veterinary biologics control program.

BIOTECHNOLOGY PRODUCTS

It was evident in 1982 that the use of recombinant DNA (r-DNA) techniques would soon result in the development of several new and innovative veterinary biological products. The primary issue concerning research with r-DNA–derived microorganisms was about maintaining proper containment. However, as new r-DNA–derived biological products began to appear, the focus began to shift to determining what procedures should be applied to permit the release of these new products from containment. In anticipation of receiving applications for license for r-DNA–derived biological products, the veterinary biologics licensing staff began to develop licensing requirements for r-DNA–derived products that would provide a clear licensing pathway for applicants. Review of scientific literature and consultation with scientists from Veterinary Biologics Laboratory, university research scientists, vaccine manufacturers, and other government agencies involved with this new technology, were used to identify the issues that needed to be addressed. It became evident that the risk of releasing r-DNA–derived veterinary biological products would depend on the nature of the product involved. That is, monoclonal antibodies, purified subunit vaccines, and inactivated products would present low risks and should be evaluated the same as conventional products; live gene–deleted products would present a moderate risk similar to conventional modified live products; and live vectored vaccines would present a higher degree of risk and would need a greater amount of evaluation prior to release from containment. The categorization of products in this manner helped to simplify the problem and also led to the development of risk assessment procedures for each category (3).

APHIS, VS licensed the first live, gene-deleted, pseudorabies vaccine on January 16, 1986. Because of the public concern regarding the release of this live r-DNA–derived product, procedures for review and licensing were adjusted for subsequent r-DNA–derived products to permit public participation in the process as required under the National Environmental Policy Act. This included the preparation of an environmental assessment (EA) with a finding of no significant impact (FONSI) before release of live r-DNA products from containment for controlled field trials and a final EA and FONSI prior to licensing of such products. Notification of the preparation of each EA and the findings were published in the Federal Register for comment. Public hearings were held to review protocols for release of live r-DNA products for field trials to identify public concerns that needed to be addressed and a VS Biotechnology Committee of interagency scientists was also established to provide peer review of risk assessments. Following this process, the industry has developed and the USDA has licensed a variety of new r-DNA–derived vaccines and diagnostic products for the poultry industry.

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