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ISN

MALI LIVESTOCK SECTOR II PROJECT

CENTRAL VETERINARY LABORATORY

Review of Animal Disease Quarantine Building

and

Laboratory Containment Building

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John L. Hyde

John L. Hyde D.V.M.
USAID/Chemonics
International Consultant
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Objective:
Assess CVL animal disease quarantine and laboratory containment buildings for possible improvement, modifications, reorganization and utilization to best contain contagious disease organisms (agents) being studied or to be studied in the future under the level of containment designed and constructed.

Approaches and Plan of Work:

1. Check the integrity of facilities = how good are they

2. Determine level(s) of containment possible with current facilities as built.

3. Determine level(s) of containment required for proposed work. What is reasonable and effective.

4. Identify what may need to be done, if anything, to realistically meet those levels, (identify changes, costs to modify and cost to operate facilities once completed).

5. What operational protocols can be initiated to provide good containment. Examples are control of the movement of people, animals, vehicles and "things" along with decontamination, directional air flow and waste treatment.

6. Will operational protocols and changes be realistic, understandable and acceptable to those responsible for operating the facilities.

7. Document findings and where appropriate suggest recommendations that might be incorporated into future modifications and operations of the facilities.

8. Where possible identify costs and make recommendations concerning changes or modifications that may be desirable. Also who might do the work and where might essential items be found and purchased.

9. Other recommendations concerning modifications, construction and rehabilitation that may be desirable and realistic.

INDEX

1. Title Page..... -

2. Summary..... i

3. Report of Findings and Some Suggestions..... 1

Addendum I - Disease Containment and Some Suggestions..... 8

Addendum IIA - Drawings of Animal Disease Quarantine Building...10

Plan A.0 Building as is on 9 May 1991.....11

Plan A.1 Plan to isolate vaccine testing area and install hot water, toilet, laundry and new doors.....12

Plan A.2 Same as Plan A.1 plus traps for drains, air-conditioning additions, autoclaves, airlock rooms, air exhausts from each area.....13

Plan A.3 Same as Plan A.2 with corridors to incinerator, central air supply and individual air exhausts in each room. Provides best overall containment.....14

Addendum IIB Drawings of Laboratory Containment Building.....15

Plan B.0 Building as it is on 9 May 1991.....16

Plan B.1 Modification to isolate cubicles (work rooms) to minimize cross contamination. Also not shown: traps in floor drains, shower. Autoclave is single door, not double door.....17

SUMMARY

For the record as well as for factual and historical reasons this consultant in 1982 recommended and documented the following. "We recommend that the $500,000 earmarked for construction of a high containment facility be spent as follows: since the diseases being studied are not exotic to Mali, $250,000 could be used to rehabilitate existing animal handling facilities and erect fencing which should then provide holding areas for testing biologics (i.e., vaccines and bacterins) for safety and efficacy in the host animal before being sent to the field. This quality control is very important in assuring that the best products are utilized in the field."

That statement is still true as long as we are discussing vaccines and bacterins against diseases that are known to exist in Mali (endemic diseases) and those products are intended only for use in Mali. That does not imply that good containment facilities for housing animals and testing those biologics for safety and potency (efficacy) under a good biological containment level (e.g. Level II or Level II plus some of Level III) is undesirable. On the contrary, one can exert better control over the degree of exposure to a challenge dose of the causitive disease agent(s). You have more flexibility in that you should be able to work with more than one disease at a time. Also you are located next to your experimental or research laboratories and thus can take frequent samples that should give you more definitive information about your products such as when do the various antibodies begin to appear following vaccination; how early does protection against infection occur; how stable are vaccines exposed to varying temperatures for varying periods of time; is there transmission of protection or of infection to the fetus or newborn; what is the infectious dose needed to produce clinical and subclinical infection; how long does protection last after vaccination, etc. etc.? In other words you can learn more about the product and the disease process in containment facilities that are constructed and even more importantly operated in a way that minimizes accidental infection caused by cross-contamination.

The facilities do require some changes and additions that are identified in the attached report. These concern directional air flow, modifications in the plumbing (drain lines), and protecting electrical outlets and fixtures to reduce the chances of accidental electric shock when water is used to clean the buildings. Also, a construction engineering firm should conduct studies to determine the structural integrity of the buildings as they are now. Obviously, it is not wise to spend monies on major modifications, changes, additions, etc. if the buildings are not structurally sound.

On the positive side, there are few countries that are fortunate enough to possess such facilities including most so called "developed countries". With modifications, these facilities are ready to work with, and contain, diseases that exist in Mali and many other countries in Africa. These diseases are of great economic importance to the various domestic animal species found in Africa as well as to many wild animals. Some of the diseases have an adverse effect on human health; two examples are bovine tuberculosis and brucellosis.

No matter how good containment facilities are, in the final analysis, they are only as good as the way they are operated. Therefore it is extremely important that operational methods be well documented and adhered to in the day to day operations of these facilities. This, of course, will be the responsibility of the Director of the Central Veterinary Laboratory and the scientists, up through government officials of the Ministry responsible for the laboratory. They must assure that the facilities are operated as designed. In this connections, the Director of the CVL must have broad delegated authorities that will maximize safe operations. To be effective these must include disciplinary measures. Based on the degree or seriousness of the biosafety infraction, this could range from a reprimand, to loss of pay and even to the loss of the employee's position. These subjects are in writing at other similar laboratories and can be made available as guide lines for the CVL and Ministry. It requires careful study.

There are different levels of safety for working with various diseases. These range from minor requirements to very strict requirements and are designated as Level I, the lowest, up to Level IV, the highest, containment. For a few very serious diseases there is even a Level V. Malian scientists and their colleagues in other countries in Africa should assign the various causitive animal disease agents to the appropriate level of containment needed to work with each disease in a safe manner.

Once the facilities are operational, one would hope or assume the Central Veterinary Laboratory would become a regional center for certain animal disease work in West Africa and perhaps an international center for all Africa and some other parts of the world.

The initial mission of such a center could be "Vaccine Research on Animal Diseases in Africa Having a Major Adverse Economic Impact on Animal Production". It would also be a logical place for testing the efficacy of different animal disease vaccines produced in other countries.

If the identified modifications are completed, the level of containment should be Level II plus many important items required for Level III. This is indeed a highly significant achievement in efforts aimed at the prevention (vaccines), diagnosis, control and, perhaps in the future, even the eradication of many serious animal diseases found in Africa and in some cases, other parts of the world. Future success will depend on dedication to proper operation of the facilities, well trained, respected and supported safety personnel to make it work, preventive maintenance and repairs of equipment, machinery, and up-keep of the containment buildings and the rest of the Central Veterinary Laboratory complex and a continuing source of funding to keep all of this on line. There should be no attempted "short cuts" in operating at the assigned biosafety level. If you can not do it right, shut down the containment facilities and stop the work.

There is more elaboration on fire prevention, first aid, human health, incinerator operations, sewage disposal, drain lines, traps, electrical fixtures, windows and each individual building in general in the attached report. FInally it is suggested that serious consideration be given to having a person knowledgeable in biocontainment construction and requirements look at future blue prints for adequacy and details before letting bids and/or starting renovations. The same person or one who has proven experience operating containment buildings and responsibility for the necessary guidelines and instructions, should assist the CVL Director and his designated biosafety officer (supervisor) in preparing similar materials for the CVL. He should also participate in testing the buildings before they are accepted to determine if they meet the operational design criteria.

I. REVIEW OF TWO FACILITIES AT THE CENTRAL VETERINARY LABORATORY (ANIMAL DISEASE QUARANTINE AND LABORATORY CONTAINMENT BUILDINGS)

Location:
The two buildings seem to provide enough space, and the locations are inside the major veterinary laboratory compound - that is good for biological safety containment and control, if properly operated.

Incinerator:
There is an incinerator but not a true pathological incinerator in that it has only one burning chamber. We do not know the temperatures it can achieve or how well it works, in other words, how efficient it is.

Pathological incinerators have two chambers aimed at achieving complete burning and ashing. The after or secondary burning chamber gives more assurance of complete burning. Incinerators with two chambers are expensive to operate and unless properly constructed they are difficult to operate.

Incinerator Access:
As now built, everything to be incinerated must go outside the buildings and is directly exposed to the ground and air (environment). This is not good. A connecting hallway to the incinerator from the Animal Disease Quarantine Building should be constructed between the autopsy room and the animal room where vaccines will be tested. The end of the hall, next to the incinerator, should have a door that opens into an enclosed incinerator "charging room" so materials can be safely put into the incinerator while protecting the environment as well as the person(s) charging the incinerator from accidental burns or asphyxiation. Also, there will be a need for small doors or vents in the wall of the charging room to allow additional air supply during burning times. These will need to be closed during other times.

Most important is a need to "lite-off" the incinerator from a remote location. From what was said, the present method of doing it through the open incinerator door is a hazard.

The hall between the autopsy room and the incinerator should exit through a new door directly opposite the autopsy room and connect with the other hallway leading from the large animal vaccine testing room to the incinerator. The present autopsy room door opening to the outside incinerator is near the end of the cold room and it is virtually impossible to move anything to the incinerator; it is too "cramped".

Sewage Decontamination:
This looks good on the blueprints except, the drain lines appear to lack "traps" in the rooms with drain openings. The traps mentioned above are essential to prevent cross-contamination between various rooms. Also they can help prevent plugging of sewer lines and provide an access place to clean out plugged lines. Finally, there is a need for a lid or cover outside the containment buildings where the drain lines come together to assist in cleaning out plugged drain lines and for maintenance of the outside part of the systems.

Heating of sewage is expensive and so is chemical treatment. This could be operated as any other regular sewage treatment facility as long as the work is with Level II diseases found in Mali. The waste can be pretreated by a good room wash down using a detergent. If done right, this is 95% of proper decontamination. It should be followed by a thorough rinse. After each experiment, wash down and rinse, the room should be sprayed with an effective decontaminant (liquid) or by gas treatment with formaldehyde gas generated from paraformaldehyde chips. This is easily done by heating the chips in a temperature controlled vessel like an electric frying pan.

Regular effluent or drainage from toilets, animal rooms and laboratory rooms, could go directly to a sewage processing plant if it is not hot, or to septic tanks and leaching fields followed by soil percolation. One should avoid processing heavy metals or harmful chemicals until they have been rendered harmless. If they cannot be so treated and disposed of, then use methods approved for disposal of hazardous waste chemicals, metals and radioisotopes.

The Animal Disease Quarantine Building:
The design of the building appears to be good. However, there are some indications in the autopsy area that the integrity of the building or the construction materials may leave much to be desired. The walls in places are cracked, and on one side, the outside wall is pulling away from the building. Also the sidewalk has broken in one area and fallen in about 10 cm. The one wall inside the autopsy room shows a significant peeling of paint suggesting a water leak or use of poor paint.

As presently designed to operate, the supply and exhaust air will mix resulting in contaminated air moving throughout the various rooms. This is because supply air from the air conditioners is exhausted back to the air conditioners and recirculated. This saves on energy but is not desirable in providing correct directional air flow to minimize contamination. This is an important problem and unless corrected, one must be aware that potentially contaminated air is being supplied to all areas of the building including so called "clean areas".

There is no hot water supply to many rooms. Hot water helps in wash downs and decontamination as well as when people take

showers. People do not stay in cold showers very long. There is also the need for one or more hot water tanks. People at the CVL want solar heated tanks which if they work should be good and save energy. However, it may be wise to also add an electric heating coil in case solar alone is not enough.

The walls should be monolithic or one continuous, impervious sealed surface. Epoxy paint would most likely provide that and stand up better and much longer to cleaning and disinfection than regular painted surfaces.

As mentioned above there appear to be no traps in the drains from the various rooms. Without traps, air can move directly from one room to another and thus serve as a route for cross contamination. Also the drain openings are too long and are really a hazard if an animal or human gets a foot caught in a crack in the grills covering the existing drains . Those drains should be trapped and made smaller (about 12 inches or 30 cm square). Suggest filling the rest of the drain with concrete and surfacing it like the rest of the floor. Traps should be sloped or slanted, be the same diameter as the drain lines, be attached to the drains with a sealed weld that does not leak and contain two strainers, one at room level and one below it, to prevent objects getting into the drain lines and causing a plug or stoppage. Also the drain strainers should be made of good metal. The present drain covers, where they exist, are made of plastic and many have already broken. Also, they will not stay in place; they are too light. The large grills presently covering the drains in the animal rooms and autopsy room should be permanently removed. They are a hazard to both man and beast.

Electrical Fixtures:

As presently installed electrical fixtures are a serious hazard. They could cause electrical shock - especially when rooms are being cleaned (washed down) and decontaminated. The electrical outlets should be made safer by covering them with a snap type cover that will be waterproof. Install covers like those over the electrical outlets in the class II "Nuaire" biological hoods.. The lights should be water proofed by building leak proof boxes around them or being recessed into the ceilings in a leak proof cover which can be opened to service them and reclosed so they are again water-tight. Rubber gaskets might be used.

Windows:

There are a lot of windows throughout the animal disease quarantine building. They look nice and are an efficient source of light. However, they are not airtight. It would be preferable to seal the windows in some substance like silicon or rubber gaskets to make them airtight. However, this is not a requirement as long as there is directional air flow and the diseases being studied are those that exist in the country and only require Level II containment.

Level II containment means the disease agents are of moderate potential hazard to personnel, animals and the environment with minimal potential economic loss. This should be very minimal at the location due to isolation of the entire complex of buildings, lots of air dilution and no susceptible animals near the complex. However, it may be desirable to confine one or two susceptible animals next to the buildings to purposely serve as "sentinels" to pick up any disease agents that might escape to the outside. They could serve as a excellent method of monitoring the air, water, incinerator and drains from the buildings to determine the degree of risk and whether the operations being used are effective and safe.

Laboratory Containment Building:
This facility has some of the same problems seen in the animal disease quarantine building. It needs traps in the drain openings. The air is circulated better than the other building but there is still an excellent chance of contaminated exhaust air mixing with supply air. This means all areas within the building could be potentially contaminated and only one disease agent or one diagnostic specimen should be studied at a time.

The ceiling appears to have a separate exhaust in the bigger room. If so, that is good, but the filter should be changed and directional air flow of the room tested. Actually a test run is needed for the whole building to determine efficiency of directional air flow, drainage system, showers, autoclave, and movement of people, materials and "things".

On the blueprint the autoclave is shown as a double door autoclave. Actually, it is a single door autoclave and is only operable from within the laboratory. That is all right but precautions are needed to assure materials are properly sterilized before leaving the building. This is an operational matter and like all other operations must be written in an understandable manner. Also, all operations will require training so people know how to do the necessary operations. No disease studies should start in any of the containment buildings until all equipment has been proven to operate correctly and necessary safety procedures and operations are shown to be understandable and complied with.

For Level II containment operations, the laboratory containment building is most likely acceptable with some modifications that may be identified after testing the building. However with more serious animal diseases and those posing a health threat to humans, the containment could be tightened by improved air supply and exhaust, mandatory showering out of the facility, installing traps and preferably a double door autoclave to sterilize materials out of the facility. Here again, strict operational instructions must be followed.

The walls should be painted with an epoxy paint to provide a strong inner wall and impermeable surface that is easy to wash (clean) and decontaminate. Also the electrical outlets and lights should be made water tight as suggested for the animal disease quarantine building.

Finally, anything exiting this building should be decontaminated or autoclaved in a double layered plastic bag and moved into the shower stall. There it should be decontaminated and rinsed before it is removed from the shower stall to the incinerator or other buildings. Sewage should be treated the same way as that from the animal disease quarantine building.

There is a need for manometers or gauges in the two buildings to give an indication of the directional air flow and to balance the air throughout the buildings.

Physical Isolation of Animal Disease Quarantine Building, Laboratory Containment Building, Incinerator and Sewage Decontamination (plus the CVL location):

This entire complex of newly constructed facilities including the incinerator and sewage treatment facilities should be isolated to provide another step in containment . It should be fenced to a level of about 8 feet and topped with strands of barbed wire slanting outward and preferably inward to deter human and animal movement into and out of the area. Appropriate signs should be posted and there must be strict control of vehicles and personnel movements in this area, including animals and supplies into the area and movement out of the area. Before exiting the area, materials should be properly treated (decontaminated) and move only to designated areas for disposal or storage. They should not be stored or mixed with items or materials from other areas.

Manual of Operating Instructions

There is a critical need for written instructions on how the facilities including movement of personnel, animals, food, cleaning and decontamination, will operate to provide the best containment or safety operation possible at the level of containment selected i.e. Level II or Level II plus shower. One may wish to address higher requirements and operating instructions in case consideration is given to Level III operations in the future.

Fire Prevention and Fire Fighting

This needs careful review and evaluation to provide the best level of fire prevention, fire-fighting and personnel safety as possible under the conditions existing at the CVL. This should include what

needs to be done to improve capability to prevent and fight fires in a safe manner. This must also address training and practice exercises that initially should be given and directed by experienced local fire fighters.

The various buildings at the CVL all pose a serious threat for outbreaks of a fire from several sources including but not limited to Bunsen burners, electrically operated equipment, various chemicals that pose a serious danger if not properly stored and used, cigarette smoking, especially, in areas where there are combustible materials, fuel storage areas, vehicle storage, etc.. A good thorough walk-through with experienced fire fighters knowledgeable about such items could be very valuable in fire prevention and how to safely and effectively fight fires based on their cause(s), for example, electrical, chemical, gasoline or fuels, paper etc. Based on these findings, one could strategically install fire hydrants, fire hoses, and proper fire extinguishers an make decisions on personnel safety and fire exits, emergency treatments, etc.. Also conduct exercises to familiarize personnel with proper exits, how to select and use the right fire extinguisher, how to fight fires, etc.. One item that might be a problem is trying to exit the various buildings because there are a number of doors that are locked or can't be opened.

Serious consideration should be given to the installation of smoke and ion detectors throughout the various buildings. They should be tied into one or more alarms and display panel to show where the smoke or fire is located. Laboratories are dangerous places. Prevention programs, precautions and frequent monitoring and testin can go a long way in minimizing those dangers.

As many persons as possible should receive training in first aid with emphasis on cardio-pulmonary resuscitation (CPR). This trainin must be given by a person that is officially qualified to do it.

The large animal disease quarantine building, especially the room where vaccines will be tested, must be a two person operation. No single person should be inside the animal holding rooms unless ther is another person outside the room who can watch activities in the animal room(s) and be able to communicate with any person in the animal room(s) in the event of an accident or need for assistance. This is very important and will require installation of a sealed glass viewport protected from breakage between the "clean" hallway and animal room(s).

A preventive human health program should be in place. This should include taking blood and separating it for frozen serum samples. Consideration should also be given to freezing samples of whole blood. These "base line samples" must be saved. Repeat blood and serum samples should be taken annually. A physical exam should be done annually on employees working within the various CVL laboratories. A physical exam should be more frequently done on

those people known to be working with human pathogens. Also quarterly or semiannual radiographs should be done on those working with tuberculosis. People should be vaccinated with the new rabies human diploid vaccine and receive "booster" inoculations as recommended.

Addendum I

DISEASE CONTAINMENT - Some Suggestions

Primary - Animal Room or Lab Room (Room Integrity): walls, drains, doors, etc.

Secondary - Directional Air Flow
a. with air dilution, a major factor - very good
b. with filtration of air - best
c. manometers or air gauges measuring in water pressure can be helpful

3 - Isolation = in this case: A. fencing the Lab containment building,
Animal Quarantine Building,
Incinerator and Sewage Decontamination complex.
B. Fence the whole CVL complex plus dig a 45 degree sloped ditch towards the outside wall or the CVL fence. (We should try this on a small area first to determine if it works.) It is supposed to discourage animals from jumping a fence. They do not like to jump upwards from a downhill slope.

4 - Mandatory showering, with complete clothes change is best. Otherwise, put on lab clothing or coveralls, shoes or boots for inside work. Remove them and wash hands thoroughly before exiting to the clean area. A complete change of clothing and a shower should be mandatory for the vaccine testing room. It would be best to do this on entry and exit from the room. That would protect the experiment as well as the environment.

5 - Autoclaving or chemical decontamination of contaminated waste that goes out of the rooms or buildings e.g. tissues, cultures, bedding, clothing, cages, etc.

6. Control movement of people, animals and "things". Examples of things are:
- clothing and shoes (boots)
- feed
- waste from animals (manure)
- waste from feed and bedding
- tools, shovels, laboratory equipment, ropes, cages, pails, halters
- samples taken for diagnosis (blood, tissues, etc)
- trucks and vehicles that move "things"

In other words, "things" are items removed from the Animal Room or Lab Room Buildings, or the fenced in areas, that might accidentally be moved to "clean" areas and contaminate those areas. They should be decontaminated, autoclaved, and in some cases incinerated (feed and bedding for example).

So, one must be aware of these "things" and take measures deemed important to prevent accidental spread of diseases. This can be strict or more laxed depending on the degree or level of biosafety control desired. However, one must know what levels of control are being used and if there is a biosafety break, be able to trace the likely cause.

If diseases are foreign or do not exist in the country or are very contagious to animals and in some cases man, then one must be very strict. The high level of containment required to work with such diseases (Level II plus Level III or in some cases Level IV) may not be possible as the facility is now constructed. Also, it may not be realistically achievable without strict adherance to operational protocols that must be written, understood and followed for those conditions. They can be very dangerous, economically and/or health wise.

If diseases exist in the country (endemic diseases) then you can vary the control depending on how infectious the disease is; how good the vaccine is; how long the disease organism survives in the environment; how well the facility is separated from susceptible animals; level of protection for humans, if they are susceptible to infection with the disease being studied; what are economic consequences (mortality and morbidity) and why is the work being done. For example, testing vaccine efficacy means using animals never exposed to the disease being studied. So you do not want them exposed to the disease during the test period until you do so intentionally by inoculation or other means of exposure to the virulent strain that produces disease in unprotected animals.

Mali and neighboring countries should consider using existing guidelines as references and appoint committees of scientists to begin to classify the various disease causing organisms (fungal, arthropod, toxins, viruses, bacteria, rickettsial, etc. into the safety level deemed appropriate for working with the different diseases. Hopefully, this document could be accepted in large part by all Africa but it will differ somewhat from country to country or region to region depending on the status of the diseases in the countries or regions. Some might have little or no specific disease and classify the safety level higher than another region or country with a lot of the disease.

Addendum IIA

DRAWINGS OF

ANIMAL DISEASE QUARANTINE BUILDING

for discussion purposes

A.0 Building as is on 9 May 1991

A.1 Alternative 1

A.2 Alternative 2

A.3 Alternative 3

Addendum IIB

DRAWINGS OF

LABORATORY CONTAINMENT BUILDING

for discussion purposes

B.0 Building as is on 9 May 1991

B.1 An alternative