<table>
<thead>
<tr>
<th><strong>Title</strong></th>
<th>Development of a herd breakdown report form and an accompanying investigation format</th>
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<tbody>
<tr>
<td><strong>Authors(s)</strong></td>
<td>Griffin, John M.; O'Keeffe, James; Dolan, Leonard A.</td>
</tr>
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Introduction
When the Tuberculosis Investigation Unit was established in May, 1989, part of its remit was to investigate the factors which militate against the eradication of tuberculosis in cattle. An objective was to analyse retrospective data relating to the occurrence of tuberculosis in cattle herds which were stored on the District Veterinary Office (D.V.O.) computer system. Data existed on herd breakdowns which were collected by Veterinary Inspectors in the course of their investigations into the source of the breakdowns.

The data were gathered using a standard investigation format which was designed when computerisation was introduced in 1986. Results of the analysis have been published in earlier reports (Griffin and Hahesy, 1992, Griffin, 1993).

The Unit combines a research function with a training role centred on the Veterinary Inspectorate located at D.V.O.s. Training is provided through periodic courses on epidemiological methods and also by the involvement of Veterinary Inspectors as Associate Members of the Unit. To date two groups of Associate Members have been involved in courses and projects with the Unit. The members of the groups are listed alphabetically in Appendix 1.

Initial analysis of investigations identified the complexity of tuberculosis in cattle as a disease entity. It was decided to design a new reporting format which would examine disease episodes at a more detailed level than was possible using the previous format. The new format and guidelines are the result of this effort. The format was developed through the interaction of the staff at the Unit, ERAD Management and the Associate Members.

The format underwent limited field trials by the Associate Members as it evolved. It is currently being field tested in a trial on 500 herds with confirmed tuberculosis.

The resulting data will enable detailed analysis, utilizing modern epidemiological and statistical methods, of the pooled investigations. The format will lead to a better understanding of the complex inter-relationships and interdependencies which exist between variables, and will facilitate the quantitative assessment of factors which predispose herds to episodes of tuberculosis.

Acknowledgements
The staff at the Unit would like to thank the Associate Members for their contribution in designing a format which we feel will prove the source of valuable data on the disease process we attempt to understand. We would like to acknowledge the support and assistance provided by Mr. Michael Sheridan, S.S.V.I., and Ms. Margaret Good, S.V.I..

References

Herd Breakdown Report Form

Guidelines and Definition of Terms

GUIDELINES

An investigation of an outbreak of tuberculosis in cattle has two main objectives

1. to provide information that can be used in the control and removal of disease at individual farm level and,

2. to provide information that can assist in the formulation of policy in relation to the V.I.'s area, and at DVO, regional or national level.

To fulfil the first objective, the Veterinary Inspector will be required to form an opinion as to the source(s) of the breakdown, and to give advice to the farmer on ways of removing these source(s) and preventing their recurrence. This will require detailed information on possible risk factors and management practices on the farm. A checklist of the information that is needed to fulfil this objective is provided in the Field Investigation Manual.

**It is essential that the V.I. keep a written record of the information that he/she has gathered.** The checklist could be used for keeping notes during the interview with the farmer. Full details of the farm visit should be recorded as soon as possible after this has been completed. The V.I. should use his/her own recording system to do this.

Much of the information collected and recorded during a field investigation will be of relevance only to that particular breakdown. However, some of the information, following collation and analysis by computer, will be of use in deciding future strategy in the V.I.'s area and in the framing of policy at national level. The purpose of the Herd Breakdown Report Form is to record this data in a customised format suitable for computerisation, thus enabling analysis to be carried out. **The form should not be used as a blueprint for a herd breakdown investigation methodology or as a checklist for the information to be gathered.**

The new Herd Breakdown Report Form will be a component of the new computerised information system for DVO's. When this becomes operational, much of the information on the Report Form will come directly from other parts of the computerised system.

Until the new system becomes operational, all parts of the form should be completed manually and the data should be entered on computer and analysed using the Epi Info programme.
DEFINITION OF TERMS

SECTION 1 Herd History

Part c. X,Y National Grid coordinate values, 4 figure number, calculated by the Nixdorf System from X,Y data recorded from six inch map sheet after the Agriculture Officer's reactor farm visit. If the National Grid values are not available on paper copy, values for the farm can be accessed through the DVO menu

Option 1 File Maintenance followed by Option 6 Herd/Fragment File or
Option 4 Disease Monitoring followed by Option 5 Map Fragment.

Part e.

Type of Enterprise (one or more of the following)

Dairy Milk is sold to a creamery.

Suckler Cows are being suckled by calves as part of a definite enterprise i.e. do not include cases where cows are being suckled by accident, e.g. due to a lost quarter.

Beef Cattle are kept until they are fit for slaughter.

Store Cattle are sold as stores for further feeding.

Other Examples include veal, pig or poultry production.

Part f.

Definition of Breakdown Test
The Breakdown Test is the test at which reactors are first disclosed during a breakdown or in the case of a factory lesion breakdown, it is the first herd test following the disclosure of the factory lesion animal(s).

Part l.

Standard Interpretation

Positive Bovine increase 5mms or more greater than the avian increase.

Inconclusive Bovine increase of 3mms or more and bovine increase 1 - 4mms greater than the avian increase.

Negative Bovine increase of less than 3mms or bovine increase equal to or less than the avian increase.

ERAD/TEAGASC 24 Tuberculosis Investigation Unit, UCD
SECTION 2 Residual Infection

Part e.

Slurry and manure

If the current reactors had access to farm waste which was related to a previous breakdown in the herd and was not stored or dispersed in an approved manner, this should be considered as a possible source of residual infection. The method of storage and dispersal of manure or slurry should be considered likely to aid dissemination of tuberculosis if it is spread or dispersed onto grazing ground within two months of the last addition of manure or within six months in the case of slurry.

Buildings

If the current reactors were kept in buildings which had been used to house reactors during a previous breakdown and were not properly disinfected in the meantime they should be considered as a possible residue of infection.

SECTION 3 Cattle Purchases

Part c.

Restricted at first test following sale - If a private test preceded a complete test on the herd following the sale of the animal, the results of both should be considered in relation to this question. If more than five herds of origin were involved, record five of these giving priority to those that were restricted either before or after the animal under scrutiny was sold.

Part d.

Information for this part should be obtained by checking the animal identity card for mart stamps and lot numbers. On the basis of this information, you may be able to conclude that the reactor animal(s) were kept in other herds prior to arriving in the current reactor herd.

Part e.

A reactor animal should be considered as linked to a previous tuberculosis breakdown if it was present in a herd while it was restricted, or if the herd was restricted at the first herd test post sale of the reactor.

SECTION 4 Farm Fragmentation and Cattle Groupings

The main purpose of this section is to get an indication of the risk for animals kept on different fragment types.

A piece of land should be considered to constitute an individual fragment if it is completely separated from all of the other pieces of the farm e.g. by a neighbour's field. However, a road or a river should not be considered to constitute a separation.
Home farm: The fragment of land on which the farmer lives and which contains the main farm buildings. If a farmer lives away from his land the home farm is that fragment of land which the VI considers to be his main piece of land.

Outfarm: Any fragment other than the home farm which is owned by the farmer.

Rented land: Any fragment of land rented by the farmer. Rented land that is attached to a home farm or outfarm should be considered to be part of these fragments and should not be described separately.

Commonage: Any piece of land held in common with other farmers.

**SECTION 5 Contiguous Bovine Source**

**Part c.** Where there are more than 4 concurrently restricted herds please use a supplementary sheet to record the details and securely attach it to the report form.

<table>
<thead>
<tr>
<th>Herd No.</th>
<th>Concurrently restricted contiguous herd.</th>
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</thead>
<tbody>
<tr>
<td>Potential period of infectivity</td>
<td>Number of months to the nearest month from the date of the last clear test prior to the breakdown, to the date of the last test where reactors were identified during the current breakdown.</td>
</tr>
<tr>
<td>Ave. herd size over restriction</td>
<td>Number of animals at breakdown test plus no of animals at clearance test divided by 2.</td>
</tr>
<tr>
<td>Degree of contiguity</td>
<td>Low: Good double fence with 6ft separation around entire farm or ditches/dykes preventing nose to nose contact between cattle. Any contact would be unforeseen and could only arise following uncommon events (e.g. power cuts).&lt;br&gt;Medium: Good disease proof barrier in place where minor breaches have occurred. Such mingling should have involved small numbers of animals (e.g. Bulls or Bulling heifers) and should be confined to periods less than 24 hours (e.g. the animals were returned as soon as the contact was realised).&lt;br&gt;High: Wide area of contact possible with neighbouring cattle and also that the contact would be for period &gt; 24 hours (e.g. any time cattle were adjoining, contact at the boundary would have been possible).</td>
</tr>
<tr>
<td>Standard reactors/Total reactors</td>
<td>Refer to the concurrent breakdown in the contiguous herd.</td>
</tr>
</tbody>
</table>

ERAD/TEAGASC 26 Tuberculosis Investigation Unit, UCD
SECTION 7  Badgers

The information on badgers should relate to the breakdown under study. Data should be given on badger carcases that were snared or found within a radius of two km, within a year prior to the breakdown or during the duration of the breakdown.

SECTION 10  Sources of Infection

Bought-in  Breakdown in a cattle herd attributed to the purchase of infected cattle

Residual  Transmission of infection to the cattle herd from or via cattle, slurry, buildings or other objects which were themselves infected or contaminated at a previous breakdown in the herd.

Contiguous bovine  Transmission of Myco. bovis to the cattle herd from cattle in such neighbouring herds.

Mechanical  Transmission of Myco. bovis to the cattle herd from outside by means of inanimate objects, e.g. vehicles, water, clothes, equipment, food.

Badgers  Transmission of Myco. bovis to the cattle herd from badger(s).

Other wildlife  Transmission of Myco. bovis to the cattle herd from wildlife other than badgers.

Non bovine species herds.  Transmission of Myco. bovis to cattle from non bovine farmed species kept in the herd under study or in neighbouring herds.

Human  Transmission of Myco. bovis or Myco. tuberculosis to the cattle herd by an infected person.

Due to NSI  The animal/s are deemed reactors due to an infection with mycobacteria other than Myco. bovis, or an infection with other related organisms causing a positive reaction to bovine as well as avian tuberculin.

SUGGESTED CRITERIA FOR SEGREGATING SOURCES OF INFECTION

BOUGHT-IN

Probable Source

The reactor/s came from a herd/s where tuberculosis was confirmed while they were present. No other likely or possible sources were identified during the investigation.
Likely Source
Similar criteria to above, but where in addition other possible sources were identified in the course of the investigation.

Possible Source
The reactor animals were purchased at a mart and the vendor's herd had no tuberculosis confirmed pre/post sale.

Unlikely Source
The reactor animals were purchased from a herd with a clear history pre/post sale and were moved without intermediate stops (e.g. in mart yards for weighing where contact with other cattle was possible). A bought-in source should also be considered as unlikely if none of the reactor animals were purchased and the herd was not self-contained.

Eliminated as a Possible Source
Reactors were home reared in a "self contained herd".1

RESIDUAL

Probable Source
The reactor/s were present in a group of cattle in which tuberculosis was confirmed at a previous breakdown. No other likely or possible sources were identified during the investigation.

Likely Source
Similar criteria to above, but where other possible sources were identified in the course of the investigation.

Possible Source
Reactors were present in the herd during a previous breakdown.

Unlikely Source
Reactor/s, while present in the herd during a previous breakdown/s were in groups that had no contact with the infected animals, buildings, slurry etc.

Eliminated as a Possible Source
The herd has had a clear history since the current reactors or lesioned animals were born.

CONTIGUOUS BOVINE

Probable Source
The reactor/s could make direct contact (i.e. nose to nose contact) with neighbouring group/s of cattle in which tuberculosis was confirmed. No other likely or possible sources were identified during the investigation.

For the purpose of this document herds which had a stock bull bought in may be described as a self contained herd.
Likely Source
Similar to the above criteria, but where other possible sources were identified in the course of the investigation.

Possible Source
The reactors had contact with animals in a concurrently restricted herd.

Unlikely Source
The reactors had contact only with cattle from clear herds or groups of clear animals from currently restricted herds.

Eliminated as a Possible Source
Cattle had no contact with neighbouring herds.

BADGERS AND/OR OTHER WILDLIFE

Probable Source
The reactor/s shared a common environment with badgers (other wildlife) which had a confirmed tuberculosis problem. No other likely or possible sources were identified during the investigation.

Likely Source
Similar criteria to the above, but where other possible sources were identified in the course of the investigation.

Possible Source
The reactor/s shared a common environment with badgers (other wildlife) of unknown disease status. Either badgers were not sampled or sampling took place and trapped carcases were Tb negative.

Unlikely Source
The farm had badger proof fencing and if the cattle were housed, badger proof housing, which prevented contact between cattle and badgers in the area.

Eliminated as a Possible Source
Following on-site investigation, there was no evidence that badgers were present on the farm or on any of the neighbouring farms.

MECHANICAL

Probable Source
Reactor/s had direct contact with contaminated material from other infected herds. Cases of shared transport would require evidence that the trailers etc were used without cleaning immediately after use with known infected animals. Similarly with labour or shared facilities, a direct link between current reactors and the contaminated material must be shown. Airborne or imported slurry must have been inadequately stored (< 6 months), and be the product of groups of cattle containing animals with confirmed lesions. The slurry must have been spread/contacted by animals within 1 month of application. Where a water source was shared, it must have been stagnant and shared with cattle/wildlife that had confirmed...
tuberculosis. No other likely or possible sources were identified during the investigation.

**Likely Source**
Similar criteria to above, but where other possible sources were identified in the course of the investigation.

**Possible Source**
Contact with individuals, materials, shared water sources, being downwind of potentially infected slurry or using a shared/contractor system of transport are all possible sources. Moving from possible to a more confident prediction should be backed by evidence of tuberculous animals being in contact with contaminated material.

**Unlikely Source**
No contact between reactors and contaminated material from other reactor herds was found during the investigation.

**Eliminated as a Possible Source**
The investigation found no evidence of neighbouring herds having contaminated material.

**HUMAN**

**Probable Source**
There was evidence of contact between a human case of tuberculosis and the reactor/s. No other likely or possible sources were identified during the investigation.

**Likely Source**
Similar criteria to above, but where other possible sources were also identified during the investigation.

**Possible Source**
Contact shown between the reactor/s and persons with a past history of tuberculosis.

**Unlikely Source**
No evidence of contact between the reactor/s and persons who on clinical or other grounds were likely to be infected with *Mycobacterium tuberculosis* or *Mycobacterium bovis*.

**Eliminated as a Possible Source**
Where all persons in contact with the reactor/s were deemed to be free from tuberculosis on the basis of a medical examination.
SECTION 14

Graphical representation of the temporal relationship between the index herd and the contiguous concurrently restricted herds.

For the herd under investigation and the contiguous concurrently restricted herds detailed in section 5c mark on the chart:

(i) The last clear herd test prior to the current breakdown by entering a C. at the appropriate month for each herd
(ii) The breakdown test of the current restriction by entering X at the appropriate month for each herd
(iii) The last herd test at which reactors were identified at the current breakdown by entering R at the appropriate month for each herd
(iv) For each herd fill the distance between C and R with a solid line

(For the purposes of this document the interval C to R months is defined as the period of infectivity referred to in section 5c).
Herd Breakdown Report Form

1. a. Herd Number

   b. VI code

   c. Coordinates \( X = \) \( Y = \)

   d. Herd category \textit{prior to} the breakdown

   e. Types of enterprises on the farm\(^2\)

   \[ \text{Dairy} \quad \text{Suckler} \quad \text{Beef} \quad \text{Store} \quad \text{Other} \]

   f. Date of breakdown test

   g. Number of cattle in herd at breakdown test. (Add number of animals at first reactor retest to those at breakdown test if breakdown occurred at test types 3 or 6).

   h. Date of clearance test

   i. Number of cattle in herd at clearance test

   j. Date of last clear herd test prior to the breakdown

   k. Test type at breakdown test

   1. Classification of \textit{all} animals punched as reactors during the \textit{breakdown} by tuberculin test interpretation and P.M. result

   \begin{tabular}{|c|c|}
   \hline
   \text{No. of} & \text{No. of} \\
   \text{reactors} & \text{lesions} \\
   \hline
   \text{Positive to the standard interpretation} & \cellcolor{gray!25} \cellcolor{gray!25} \\
   \text{Inconclusive to the standard interpretation} & \cellcolor{gray!25} \cellcolor{gray!25} \\
   \text{Negative to the standard interpretation} & \cellcolor{gray!25} \cellcolor{gray!25} \\
   \text{Total} & \cellcolor{gray!25} \cellcolor{gray!25} \\
   \hline
   \end{tabular}

   m. Was tuberculosis confirmed at post test negative animals slaughtered under permit during the breakdown

   \[ N = \text{No} \quad Y = \text{Yes} \]

2. \textbf{RESIDUAL INFECTION}

   a. Is there a record of a previous breakdown on the \textit{herd file}

   \[ N = \text{No} \quad Y = \text{Yes} \]

---

1 Before completing this report please read the document "Guidelines and Definition of Terms".

2 To be completed only if a field visit has been undertaken
b. If yes - give date on which reactors were last identified at that breakdown
   - were there lesions found in one or more animals at that breakdown?
     N = No  Y = Yes

c. Are/Were there animals still in the herd which were present at a previous breakdown?
   N = No  Y = Yes

d. If yes - how many of these were reactors this time?
   - how many of these reactors had been inconclusive at a test prior to the breakdown test
     (i) inconclusive to the standard interpretation
     (ii) inconclusive to the severe interpretation only

e. Were any other residual factors likely to have served as possible sources at the present breakdown?2
   N = No  Y = Yes

3. CATTLE PURCHASES
   a. Cattle purchases in the year prior to the breakdown test2
      1 = did not buy in
      2 = bought in one animal (e.g. bull) and/or calves (animals 6 months or under) only
      3 = bought in 2 - 10 older cattle/cows
      4 = bought in more than ten older cattle/cows

   b. Number of the current reactor(s) bought-in since last clear test

2To be completed only if a field visit has been undertaken.
c. Reactor status of herd(s) of origin of reactors bought-in since the last clear test. (If more than 5 herds prioritise on the basis specified in the guidelines 3c).

<table>
<thead>
<tr>
<th>County Code</th>
<th>Herd No.</th>
<th>Restricted while reactor was present in the herd</th>
<th>Restricted at first herd test post sale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N = No  Y = Yes  U = Unknown</td>
<td>N = No  Y = Yes  U = Unknown</td>
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d. Was there any evidence, e.g. from the animal identity card, that one or more of the reactors were kept in other herds in the period between leaving the herd of origin and arriving in the current reactor herd?

N = No  Y = Yes  U = Unknown

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e. Had any of the reactors that were bought-in and had passed one or more tests in the current herd, been linked to a tuberculosis breakdown in a previous herd?

N = No  Y = Yes  U = Unknown

4. FARM FRAGMENTATION AND CATTLE GROUPINGS²

a. Total number of farm fragments

b. Which fragment was the disease originally associated with?

1 = home farm  2 = outfarm  3 = rented land  4 = commonage  
5 = combination of the above  6 = not clearly apparent

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c. How many cattle groups were on the farm at the time of the breakdown test?

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d. How many groups disclosed standard reactors?

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²To be completed only if a field visit has been undertaken
5. CONTIGUOUS BOVINE SOURCE

a. Total number of contiguous herds

b. Number of contiguous herds restricted in the period from the date of the last clear test prior to this breakdown and the clearance test

c. Details of Concurrently Restricted Contiguous Herds (i.e. herds enumerated at 5b). (Where there are more than 4 herds prioritise those with high contiguity and add the remainder to the supplementary sheet as detailed in the guidelines 5c).

<table>
<thead>
<tr>
<th>Herd Number</th>
<th>Period of Infectivity (Months)</th>
<th>Ave. Herd Size Over Breakdown</th>
<th>Stand R</th>
<th>Total R</th>
<th>Stand R</th>
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H = High,  M = Medium,  L = Low

Herd Number Period of Infectivity (Months) Ave. Herd Size Over Breakdown Contiguity H, M, L

<table>
<thead>
<tr>
<th>Herd Number</th>
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d. Was there evidence of contact between the reactor cattle and cattle considered likely to be infected in contiguous or other herds?

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<th>N = No</th>
<th>Y = Yes</th>
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N = No  Y = Yes

Due to contact across farm boundaries

Due to break-ins to or from neighbouring farms

During movement of herdowner's cattle or neighbours' cattle along roads

Due to the sharing of buildings, land or other facilities

Due to sharing of bulls for breeding

Other

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6. MECHANICAL SPREAD

a. Was there any contact by mechanical means with contiguous or other reactor herds which may have been the source of this breakdown?

\[ \text{n = No} \quad \text{Y = Yes} \]

- Farm personnel/labour
- Shared facilities
- Shared transport
- Water courses

b. If yes - how many badger carcases were sent for laboratory examination?

\[ \text{No. examined} \quad \text{No. positive} \]

(i) snared under license
(ii) other carcases, e.g. road casualties

7. BADGERS

a. Were there any badger setts on or adjoining the farm?

\[ \text{n = No} \quad \text{Y = Yes} \quad \text{U = Unknown} \]

(i) on the farm
(ii) adjoining the farm

b. If yes - how many badger carcases were sent for laboratory examination?

8. OTHER SPECIES

a. Were domesticated or feral deer or goats present on or around the farm at the time of the breakdown?

\[ \text{n = No} \quad \text{Y = Yes} \]

- Deer
- Goats

b. If yes - Was there evidence of tuberculosis in these or in any other feral species?

\[ \text{n = No} \quad \text{Y = Yes} \]

- Deer
- Goats
- Other

9. HUMAN SOURCE

a. Was there any indication/evidence of a human source in the breakdown?

\[ \text{n = No} \quad \text{Y = Yes} \]

---

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10. SOURCES OF INFECTION

1 = Probable source  2 = Likely source  3 = Possible source
4 = Unlikely source  5 = Eliminated as a source

Bought in  Residual  Contiguous bovine source  Mechanical

Badgers  Other wildlife  Non bovine farmed species  Human

11. WHICH DO YOU REGARD AS THE MOST LIKELY SOURCE OF THIS OUTBREAK?

1 = Bought-in  2 = Residual  3 = Contiguous bovine  4 = Mechanical
5 = Badgers  6 = Other wildlife  7 = Non bovine farmed species  8 = Human
9 = NSI  10 = Not clearly apparent

On what basis did you make this decision?

12. WHAT WAS THE LEVEL OF CO-OPERATION FROM THE HERD OWNER IN IMPLEMENTING YOUR RECOMMENDATIONS

E = Excellent  G = Good  A = Average  P = Poor  B = Bad

13. ANY OTHER COMMENTS ON THE BREAKDOWN

---

2) To be completed only if a field visit has been undertaken
### 14. TEMPORAL RELATIONSHIP OF INDEX HERD TO CONCURRENTLY RESTRICTED CONTIGUOUS HERDS

**Concurrent Restricted Herds**

<table>
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<tr>
<th>Herd No.</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
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For each herd above mark (i) C = last clear herd test prior to current breakdown, (ii) X = breakdown test, (iii) R = last herd test at which reactors were identified at the current breakdown, (iv) Join C--R
Details of Concurrently Restricted Contiguous Herds where there were greater than 4 herds involved.

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<tr>
<th>Herd Number</th>
<th>Period of Infectivity (Months)</th>
<th>Ave. Herd Size Over Breakdown</th>
<th>Degree of Contiguity H, M, L</th>
<th>No. Reactors</th>
<th>No. Lesions</th>
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